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A YEAR OF EXPORT TRADE.

The detailed statistics are now out for December so that one can get results for the whole year of the electrical export trade. The month shows the same general trend that has marked all its recent predecessors, in a gain in the smaller articles and a continued falling off in the heavier machinery. It appears that the December, 1909, export of electrical instruments and apparatus was $681,868 as compared with $611,616 in the preceding year. On the other hand, this gain of $70,000 was offset by the machinery slump, the figure for last December being only $461,149 as compared with $585,559. The totals of the 12 months are $7,063,804 for instruments and $5,963,746 for machinery, giving a grand total of $13,567,550. In 1908 the total was $12,613,730, but in 1907 it was no less than $17,460,775, so that 1909 was nearly $4,000,000 below that high water mark practically the whole of which was in heavy electrical machinery. The minus difference in this class between 1909 and 1907 was $2,741,484.

When we come to examine the data more closely it is seen that the losses are so widely distributed as to leave little room for the idea that we have lost the market in any given country because of some particular reason, such as a high tariff or hostile boycott. The fact seems to be, and there is some consolation in it, that the worldwide financial and commercial depression has checked enterprises which would call for our material. As such enterprises revive we shall be in the game just as much as before. Some of the trade movements are a little complex. Thus, British North America, in demand for small apparatus, rose from $1,380,926 in 1907 to $1,958,412 in 1909, while its requirements of electrical machinery fell off from $1,543,450 to $623,121. In Mexico heavy machinery fell from $1,551,562 to $669,007, but apparatus rose from $753,936 to $834,578. Our trade with the United Kingdom in both departments was shot all to pieces, but a stronger note of confidence is now heard in the British Isles, and it may mean that larger orders will be forthcoming.

It would be interesting to know to what extent our ability to export electrical goods to the common markets—or any other goods—is affected by what is summed up in the phrase "the high cost of living." The general decline in exports may certainly in some measure be ascribed to high wages, dear raw materials, high rents and similar factors, and these might well offset quite largely skill and invention and production on the large scale necessary to supply the wants of 90,000,000 progressive, active people. High prices tend to check consumption, and if this be true of home demand, it may apply just as effectively to foreign. Perhaps another full year may be required to show just what are the permanent conditions and in just what directions it is best to apply the effort for cheaper production and wider markets.

Weekly Record of Electrical Patents

UNITED STATES PATENTS, ISSUED JAN. 25, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

947,224. TELEGRAPHIC TRANSMITTER; Patrick B. Delany, South Orange, N. J. App. filed March 23, 1907. Auto-dot key for making dots automatically by current impulses of uniform strength and dashes by current impulses of uniform and less strength than used for dots.

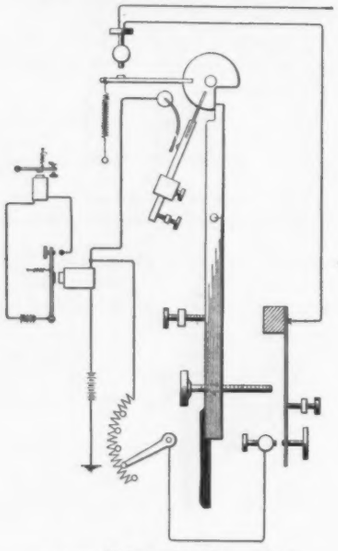
947,235. VENTILATED FUSE; Edward M. Hewlett, Schenectady, N. Y. App. filed Aug. 26, 1909. Thermo-fuse having a wire of a low melting point, with means for confining the blast of exploding gases to the region occupied by the fuse.

947,238. STORAGE BATTERY; Walter Marsh Jackson, Stamford, Conn. App. filed July 8, 1908. A container with a storage battery plate consisting of an alloy of metallic lead, antimony and bismuth in the form of a frame with receptacle carrying the active material.

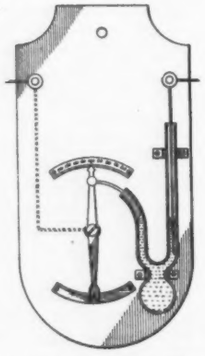
947,239. WEATHERPROOF HIGH-TENSION FUSE; Ernest H. Jacobs, Schenectady, N. Y. App. filed Aug. 20, 1909. Combination of a line wire, a branch wire, an enclosed expulsion fuse connecting the same and a sectional housing of insulating material enclosing the fuse with a disconnecting switch in series with the tubes.

947,246. APPARATUS FOR DETECTING AND EXHIBITING THE FLUORESCENCE OF FLUORESCENT SUBSTANCES; Wallace Goold Levison, Brooklyn, N. Y. App. filed Nov. 3, 1908. Fluoroscope consisting of a box containing a rotary perforated cylinder to the outside of which the specimen is attached with the source of light, the cylinder being rotated to expose the specimen first to the light and then in darkness to the view of the observer.

947,247. RESISTANCE UNIT; Edwin N. Lightfoot, Philadelphia, Pa. App. filed May 4, 1908. For telephone systems in which a fireproof insulating base carries the resistance and a pair of terminals at one end, with an insulated conducting strip between the base and resistance for connecting the other of said terminals to the opposite end of the resistance.



947,224—Telegraphic Transmitter.



947,423—Automatic Fire Alarm.

947,267. ELECTRICAL MEASURING INSTRUMENT; Maurice J. Wohl, New York, N. Y., and Harry Hertzberg, Brooklyn, N. Y. App. filed March 31, 1908. Measures the maximum energy flowing in a multi-circuit system, such as a three-wire system, by means of an indicator with a serrated member over which the indicator travels which prevents the return movement of the indicator. The indicator is actuated by a thermally expansible wire.

947,274. SUSPENSION DEVICE FOR INSULATORS; A. O. Austin, Barberton, Ohio. App. filed May 31, 1909. For high voltage insulators, including a recessed body carrying an integral head having a T-shaped recess and a suspension member adapted to interlock in said recess to suspend the unit from a suitable support.

947,313. MOTOR-CONTROL SYSTEM; F. H. Shepard, Pittsburg, Pa. App. filed May 15, 1905. Means for charging storage batteries for electric railway motors which are effective only when the compressor used to supply air to the brakes is in operation.

947,329. CONTROL SYSTEM FOR ELECTRIC MOTORS; M. Hartenheim, Hale, England. App. filed June 7, 1909. Control system for motors in which the speed and direction of rotation are controlled by varying the field of the generator which supplies the motor with energy. The generator and motor have their armatures connected in series and their fields in series and two auxiliary generators are used, one connected in the field and having a balancing conductor connected through the other to a point in the field between the two windings.

947,336. ELECTRIC-CIRCUIT CONTROLLER; H. D. James, Pittsburgh, Pa. App. filed April 10, 1908. For starting an alternating-current motor by means of an auto-transformer, including a frame carrying a plurality of contacts, vertical bars carrying movable contacts, the bars being operated by toggle links.

947,338. RAILWAY MOTOR; S. M. Kintner, Pittsburgh, Pa. App. filed May 4, 1908. For cooling motors by making the field magnets with hollow passageways and dampers for distributing cool air therethrough.

947,358. ELECTRODE; J. W. Stubbs, Middlewich, Eng. App. filed Oct. 23, 1909. Two separated straight metal bars with crossbars of carbon and cast metal connections between the bars and the carbon bars.

947,389. DYNAMO-ELECTRIC MACHINE; B. G. Lamme, Pittsburgh, Pa. App. filed June 2, 1905. An improved core for slotted armatures of an alternating-current commutator induction motor in which the width of the slots is reduced and their depths proportionately increased by using thin flap resistance conductors arranged side by side in the slots.

947,423. AUTOMATIC FIRE-ALARM; Allen W. Stafford, Iola, Kan. App. filed Feb. 26, 1909. Consists of a thermostat with two fluid-containing tubes, one curved at the upper end, a fixed contact with one end submerged in the fluid in the other tube, a pointer adjacent to the thermostat with a curved arm adjusted close to the fluid in the curved tube, a scale adapted to be locked against the pointer and the alarm circuit closed when the fluid contacts with the curved arm.

947,436. TROLLEY WHEEL; G. H. Downs, North Powder, Ore. App. filed March 24, 1908. Trolley wheel with wide flange which is prevented from leaving the wire and can pass the cross wires by journaling it between two rotatable star-wheel sides which embrace the trolley wire.

947,515. FIELD SYSTEM FOR MOTOR ELECTRIC METERS; C. W. J. Busch, Pinneberg, Germany. App. filed March 18, 1905. Electric meters with iron cores, an electromagnet having an air gap and a magnetic shunt with an energizing winding which absorbs the remnant magnetism to render the field within the air gap proportional to the current in the stationary coil.

947,547. SOCKET SHELL CAP FASTENING; H. Hubbell, Bridgeport, Conn. App. filed Sept. 11, 1909. The shell has a slot and locking lugs and the cap and internal groove for locking shoulders with outwardly projecting lugs.

947,575. STORAGE BATTERY; J. E. Hascke, Chicago, Ill. App. filed Nov. 7, 1908. Portable storage battery for automobiles, including a plurality of glass cells arranged side by side with plates and electrolytes in each cell, a central vent for each cell and a casing for the cells.

947,601. CONNECTION FOR WIRES OR CONDUCTORS; E. Schmider, Nuremberg, Germany. App. filed March 23, 1909. For reducing the length in twisted joints. Uses a guide tube which receives the two wires with a circular nipple extending longitudinally from the tube at one side of each end.

947,612. HIGHWAY CROSSING DEVICE FOR ELECTRIC RAILWAYS; D. T. Fisher, Columbus, Ohio. App. filed Jan. 2, 1909. Crossing for electric roads with low trolley wires. Automatically raises the trolley wire after the passage of the trolley car to clear vehicles and lowers it at the approach of a trolley car.

947,647. INDUCTOR GENERATOR FOR IGNITION PURPOSES; Henry Joseph Podlesak, Chicago, Ill., and Tesla Emil Podlesak, Morristown, N. J. App. filed Jan. 28, 1908. For use with reversible motors causing a spark irrespective of the direction in which the crank shaft of the engine is rotated. The inductor is unwound and movable in either direction and the coil of wire is in inductive relation to intermediate polar projections on the pole pieces.

947,677. FUSIBLE SWITCH; G. W. Goodridge, Bridgeport, Conn. App. filed May 1, 1908. Fusible knife switch, the blade being in two sections with insulation between with contacts beneath the switch blade to prevent the insertion or removal of a plug while the switch is closed.

947,686. GOVERNOR OR REGULATOR; F. J. Pearson, Chicago, Ill. App. filed Sept. 19, 1906. For controlling an electric motor which drives a pump and responds to variations in the pressure for quantity of the fluid pumped for starting or stopping the motor. Includes a sliding rod carrying a contact which co-operates with the contact on the frame and a spring between the contacts for electrically connecting them together with two contacts on the frame engaged by the contact on the rod.

947,687. MAGNETIC CLUTCH; H. W. Ravenshaw, Hanwell, England. App. filed Aug. 26, 1909. An annular trough-shaped magnetic clutch comprising the combination of a spider with a flat annular base having a trough holding an annular energizing coil which is wound directly on the spider instead of on the spool.

947,692. LIGHTNING ARRESTER; W. A. Binion, Lisbon, N. Y. App. filed Feb. 26, 1909. Includes relatively movable electrodes with an electromagnet for holding them separated with means for submerging them in a body of insulating liquid when a lightning discharge passes through the arrester.

947,709. ADJUSTABLE DROP LIGHT ATTACHMENT; F. F. Bartholomew, Campbell, Cal. App. filed March 17, 1909. Details in adjustable chandelier.

947,723. REDUCTION OF SCRUFF AND DROSS; R. S. Wile, Pittsburgh, Pa. App. filed June 28, 1907. Tin furnace in which the material is fed into an electric furnace and the volatilized metal condensed, oxidization being prevented within the furnace.

947,733. ELEVATOR SIGNAL SYSTEM; H. J. Heeney, Boston, Mass. App. filed Oct. 26, 1907. Each floor has a single annunciator set for a plurality of elevators with an up-and-down push button and up-and-down signals are provided in each car with a manually operated circuit controller therefor and also an automatic circuit controller operated by the car to destroy the signals.

947,741. APPARATUS FOR ELECTROLYTICAL DECOMPOSITION OF ALKALI CHLORID SOLUTIONS; J. J. Rink, Copenhagen, Denmark. App. filed Jan. 7, 1909. Contains a perforated cathode presenting a mercury film receiving the deposit on both sides.

947,754. ELECTRICAL CONNECTOR; S. B. Perkins, Cleveland, Ohio. App. filed Sept. 2, 1908. Connector for storage batteries consisting of a two-part, threaded bolt on which a collar is mounted.

947,763. MULTIPLE SOCKET FOR INCANDESCENT LAMPS; F. J. Russell, New York, N. Y. App. filed April 13, 1908. Provides for carrying a variable number of lamp holders particularly for porcelain sockets. Details.

947,768. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; F. W. Young, East Orange, N. J. App. filed July 19, 1909. Combines with the commutator bar, a zigzag folded metal strip in contact with the bar which forms a continuation of the contact surface, the folds being separated by insulation.

is interesting to note that in parts of Colorado certain farmers have rented their irrigation ditch water rights to other parties and are pumping water electrically at a lower cost than the price of their ditch rights. As far as the company engaged in the electric light and power business is concerned, this is distinctly a non-peak character of load; that is, it never comes during the lighting peaks of November and December, irrigation pumping being always done in the summer. The pump generally used in this class of work is the vertical shaft centrifugal type, with the motor on the upper end of the shaft and with the pump submerged in the bottom of a shallow well. Such pumps, if well designed, can be made to show efficiencies of over 60 per cent in the 30-hp size. By having the pump submerged in the well the difficulties of priming otherwise likely to arise with a centrifugal pump are obviated. The whole combination of vertical shaft motor and pump, if proper provisions are made for taking care of the thrust caused by the weight of the moving parts, will run without attention for hours.

FEDERAL REGULATION OF WIRELESS.

Several bills are now before Congress dealing with the Federal regulation of wireless signaling, but only one of these —that of Representative Roberts—appears to meet at all adequately a situation which forcibly calls for legislative action from the national body. The Roberts bill provides for a commission to make a complete study of the subject of governmental regulation of wireless, with a view to comprehensive legislation based upon its report. The other bills now before Congress are confined to phases of a situation that should only be considered as a whole; and however meritorious intrinsically, their enactment into law would merely add complications to the work of placing Federal wireless regulation finally on a systematic and rational basis, without which Congress will continue to be harassed with, and the wireless art and industry disturbed by, all manner of proposals for piecemeal legislation. As we have previously pointed out, one of the admirable features of the Roberts measure is that the commission of seven members for which it provides and whose duty shall be to suggest a comprehensive system of wireless regulation with due regard alike for governmental and commercial interests, will not be dominated by military or bureaucratic influences, as three of the seven members are to be selected from representatives of the commercial wireless interests, and a fourth is to be a scientist well-versed in the art of wireless telegraphy and telephony. We hope the Roberts bill will receive favorable action at the present session of Congress, and will lead eventually to a settlement, having elements of finality, of a situation that otherwise might be the subject of ill-advised and incomplete legislation tending to retard an art that deserves the warmest encouragement, despite its sorry stock-jobbing record.

Elsewhere we print a communication by Dr. Lee de Forest treating of a detail relating to the question of governmental wireless regulation. Should the Roberts measure be enacted, the views of Dr. de Forest, as those of an able authority on the subject on which he writes, merit careful attention by the proposed commission. The subject brought up for discussion by Dr. de Forest may aptly be considered through the medium of mechanical analogy. If a receiving antenna be likened to a single vertical stretched harp-string, capable of being set into vibration as a means of signaling, then it is evident that if such an æolian harp is mounted on a suitable resonance chamber, a feeble sound of the right pitch, carried through the surrounding air, can excite the harp into resonant vibration, and make it give a corresponding signal. On the other hand, a sound of similar, or even of much greater intensity, but of the wrong pitch, will fail to set up the vibration. This is equivalent in the electromagnetic case of saying that tuned receivers can be adjusted to respond selectively to the electrical pitch, or frequency, of waves from a particular sending station. But whatever the pitch of the æolian harp-string may be, a sudden blow or explosion, in the air, if powerful enough, can throw it into vibration. If the impulse forms a sudden single wave, it can force the receiving harp to give out a vibration signal, although such a single impulse must have enormous damping, and does not possess any frequency. This means, in the electromagnetic case, that if a sending station emits merely single-wave impulses, of sufficient intensity, they can force signals in any ordinary tuned receiving antenna system, although the emitted waves do not belong to any frequency. The more persistent the wave-trains of any pure electric frequency emitted from a sending antenna, the more readily they can build up a sympathetic response in resonantly tuned receiving mast systems. That is to say, the less the damping of the emitted waves, the better they can build up a received current in correspondingly tuned receiving antennas. But, for a given signaling range, the sender can make up for large damping by intensity and power in his emitted waves. Single impulses, of infinite damping, will serve, if he uses power enough; but then he will probably interfere nearly equally with all receiving stations in range, no matter what their pitch may be.

Two criteria may be used to exclude the above type of electromagnetic offender. The first is that his power shall be limited, so that his sudden bangs on the ether shall not jar his near neighbors into false signals. The second, or alternative criterion, is that his damping shall not be excessive—that no single waves may be used, or wave-trains of very brief and rapidly decaying sequences, but that there shall be a real "sing" to the impulses, with an ample wave-train to each. This means that the ratio of one amplitude to the next in the same direction shall be say not more than 1.05, which would involve a logarithmic decrement not greater than about 0.05. (There is apparently an error in the mathematical expression of the "co-efficient of damping" in the our correspondent's letter.) Dr. de Forest evidently prefers the second plan, apparently because he thinks it more difficult to assign limits to the kilowatt-capacity of a sending station, manifestly long-distance stations needing more power than short-distance stations. On the other hand, the measurement of the damping coefficient of a sender in bad etheric odor among his neighbors might involve much technicality, computation, and dispute. We think it would be better, simpler and more practical, to specify the maximum power to be utilized for all ranges up to 250 kilometers, which would take care of all the short-range folk; and then to apply special requirements as to damping coefficient only for the big long-range stations that are the serious enemies to the peace of heaven and earth. A feeble-power sender with small kilowatt capacity is easily inspected on the basis of watts, volts and amperes, and he may bang the ether in slaps, if he wants to, without bothering any one afar.

CENSUS OF ELECTRICAL ENGINEERING COURSES.

Elsewhere will be found the results of our third annual census of the electrical engineering courses of the United States, covering the 1908-1909 school year. The delay in printing the statistics has been due to causes beyond our control. A comparison of statistics for the three years shows a slight falling off in graduates last year, and a very considerable decrease in the number of students enrolled. However, 1908 appears to have been a banner year with respect both to number of graduates and of students; and the rearrangement of courses in a number of schools whereby the engineering students follow the same studies during the freshman and sophomore years—there thus being no clue as to the respective branches in which they will later specialize—accounts in part for the decrease in the figure for the total number of electrical engineering students enrolled. The increase in the engineering educational standards of the schools of the highest class appears to have the effect of decreasing admission to their courses; this, however, would probably not affect the grand total, but merely divert students to other schools with less exacting requirements.

To those who still hold to the rather primitive idea of the early period of technical education, that a graduate from an engineering course is fitted only for a technical career, and, moreover, goes forth from the academic shades a full-fledged engineer, the annual number of electrical engineering graduates now turned out is doubtless appalling. On the other hand, the experience of recent years clearly indicates that the electrical engineering graduate is to be regarded essentially as raw material, subsequently to be fitted through a period of several years' training for his ultimate career, which may lie in any department—technical, industrial or commercial—of the electrical industry. While the strictly technical branches can absorb for permanent careers but a small percentage of the graduates, the industry as a whole can now utilize with advantage to itself and to the immediate or eventual advantage of the graduate, a far larger number of young men than is at present supplied by the schools. It may be asked, assuming this to be the case, do not the present electrical engineering courses give undue weight to purely technical instruction, and should not more attention be paid to economic and commercial subjects, with perhaps specific technical training relegated to the status of a specialty? One of the many replies that may be made to such a query is that by far the greater benefit to be derived from technical instruction lies in the systematic training of the mental processes incident to the study of mathematics and physical science; and beyond the inculcation of principles, in a comparatively slight degree to the acquisition of a store of specific information for practical application in actual bread-earning work, which latter knowledge can only be satisfactorily acquired by contact with such work under conditions of personal responsibility for results. Moreover, from a more utilitarian standpoint, the graduate, whether as a manufacturer's salesman or a central-station solicitor, as a business manager of an operating plant or in charge of workshops, has more confidence in every act through the possession of a systematic engineering knowledge relating to the branch to which his calling pertains. Some instruction of a commercial or industrial nature can with benefit, no doubt, form part of all technical courses, particularly if of a nature that will teach broadly the incertitude of effort of any kind that is not properly adjusted to the financial and human factors which condition success in every department of life. The danger in this direction is that a school which recognizes this consideration and starts to arrange its course in conformity therewith, may, with American impetuosity or under the spur of a president who spies an opportunity to increase the student enrollment by dangling a tempting bait before practical-minded fathers, carry the idea to a harmful extreme, and injure rather than improve the prospects of its graduates.

ECONOMICS OF SYNCHRONOUS CONDENSERS.

Synchronous machines are beginning to receive a dual recognition as to rating and capacity, The first and ordinary rating is in kilowatts of power delivered. The second, and more recent, rating is in leading kilovoltamperes, for the improvement of the power-factor of the system on which they operate. The article by Mr. B. F. Jakobsen, on page 352, is directed to the economics of the second kind of rating. It shows that when the load lags 45 deg., by reason of heavy induction motors and magnetizing currents, one leading kilovoltampere can liberate one extra kilowatt of delivered power, if the main generator is working at full output. At lag angles greater than 45 deg., one leading kilovoltampere can release more than one kilowatt, whereas at lag angles of less than 45 deg. one leading kilovoltampere can only liberate less than one kilowatt. Two cases are considered in the article, one relating to the economics of increased useful output, following the installation of a given leading kilovoltampere-capacity; and the other relating to the economics of reducing the power waste in a transmission line, following a similar installation. In the latter case, not only may power be saved in a transmission line by a leading kilovoltamperage at the receiving end, but the regulation of pressure in the system may also be much improved. The article deserves to be studied by power-transmission engineers. The cross-section and cost of line conductors may often be reduced, by improving the power-factor of the load for a given pressure regulation. On the other hand, synchronous motors are hardly equivalent to the corresponding investment in line copper, because they sometimes fall out of synchronism, whereas copper does not. Incidentally, the article, like several others lately written by power engineers, deals in special units, namely, the kilovolt and kilo-ohm. This is all well enough when an engineer is careful in his notational judgment, but the plan may not always be extended with impunity. A system of units has limitations. One volt, working through one ohm, liberates one watt, and sends one ampere; but one kilovolt, working through one kilo-ohm, liberates one kilowatt, but does not send one kiloampere. It only sends one ampere.

IRRIGATION PUMPING.

The electric pumping of sub-surface water for irrigation purposes in the arid lines of the West has been carried on upon a large scale for a number of years, especially in California. Recent developments along the same line in Colorado are interesting. It is difficult to say how far this pumping of sub-surface water for irrigation purposes can be carried. That naturally depends largely upon the water supply. Given a sub-surface water supply, there is strong inducement for electric companies to get into the field to supply this business. It

Graduates from Electrical Courses in the United States.

Three years ago this journal published the result of its first census of the electrical engineering courses of the United States, the summary appearing in the issue dated July 27, 1907. The result of a similar census for 1907-1908 appeared in the issue of Dec. 26, 1908, and below is given a summary of the census for the 1908-1909 school year. The results of the latest

TABLE I.—ELECTRICAL ENGINEERING STUDENTS AND GRADUATES, 1909.

	Number of schools.	Students, 1908-9.	Graduates, 1909.	Total graduates to June, 1909.
Class I	25	3,387	590	7,519
Class II	65	4,041	630	4,823
Class III	14	1,242	253	1,924
Totals	104	8,670	1,473	14,266

census are shown in Table I. Table II gives a comparison of the figures of the 1907, 1908 and 1909 censuses, and in Table III is given an estimate of the number of students who have entered electrical engineering courses, but have dropped out before graduation. As is explained in detail later, the classification of the courses in the tables is based upon the teaching equipment, and the relative standing of the schools and of their graduates in the electrical engineering profession.

The statistics for 1907 applied to 96 schools, those of 1908 to 100 schools, and the present statistics to 104 schools. Four new schools have been added to Class II, while two schools have been transferred from Class II to Class III. By reference to Table II it will be noted that the number of stu-

TABLE II.—COMPARISON OF CENSUS STATISTICS FOR THREE YEARS.

Year	1907.	1908.	1909.
Number of students	8,929	9,651	8,670
Number of graduates	1,358	1,501	1,473

dents is less than in 1907, and that the number of graduates is less than in 1908. As in some schools engineering students do not specialize until the end of the second year, an endeavor was made in some cases to estimate the probable number of freshmen and sophomores who would take up electrical engineering. However, it has been found impracticable in many cases to make this distinction, and as more of the schools ruled out the freshmen and sophomores in 1908 than in the previous two years, the drop in the total number of students can, to a certain extent, be attributed to this cause.

The classification of the courses is a difficult task, owing to the many factors which enter into the problem. In this classification the stability of organization and the character of the teaching equipment of the institution behind the course has been given greatest weight. While a course through being dominated by a man of exceptional ability or personal force may achieve results out of proportion to the educational facilities available, yet, because of its probable temporary character, it would not be advisable to classify the school with others having greater permanent advantages. The schools in Class I are those of highest standing, which have the most complete equipment for teaching electrical engineering and whose degrees are generally recognized as giving some prestige to the graduates. Class II includes all schools which, actually or ostensibly, give a full course of electrical engineering instruction, while Class III contains those institutions which offer an electrical course intended to train "practical" rather than professional men.

As noted above, Table II gives a comparison of the total number of students taking regular electrical engineering courses and of the total number of graduates for the last three years. The result of a scrutiny of the distribution of students among the four college classes indicated that the average freshman class is about one-third of the total student body and the sophomore class about 27 per cent or 28 per cent of the total. Based on these percentages, the reports which this year excluded the lower classes, but included them last year, have been corrected to include the lower classes. This raised the total of students to 9149, which figure is only 502 less than last year. On this basis, there is an apparent falling off of 5 per cent in the number of students.

The statistics presented show that there have been up to 1909 14,266 electrical engineers graduated from schools in the United States having systematic courses in electrical engineering instruction. They do not show directly, however, how many men have been turned out with three years or less of technical training. An examination of the reports indicates that, assuming a class of 100 freshmen, about 82 pass through to the sophomore year, 65 to the junior year, 50 to the senior year, and 47 finally get their degree. Those who leave during the first year derived little or no technical instruction; those passing the second year have received training in mathematics and the fundamentals of engineering, while those completing the junior year have had considerable training in the fundamentals of electrical engineering and usually the benefit of a certain amount of practical laboratory work. Based on these percentages the 14,266 graduates represent 47 per cent of the total which started the course—that is, 30,350 matriculated, 24,900 had more than one year of instruction, 19,700 had more than two years, 15,200 had more than three years, and 14,266 graduated after four years of training.

Applying the percentages derived from these figures, the entries of Table III are obtained, and are believed to represent very closely the facts. These partially trained men should not

TABLE III.—ESTIMATED NUMBER OF STUDENTS FOLLOWING LESS THAN A FULL COURSE.

	1907.	1908.	1909.
Less than one year	520	580	560
One year	490	540	530
Two years	435	480	475
Three years	87	99	92
Less than four years. Total.	1,532	1,699	1,657

be ignored in considering the debt that the electrical industry owes to the technical schools. Those passing into the second year are ready to take positions, for example, as draughtsmen, and are well grounded in mathematics, while those who complete the junior year are excellent raw material in the draughting-room, the testing plant, the factory apprenticeship course, or, in fact, for almost any place that a graduate can fill.

A. I. E. E. Meetings.

The next New York meeting of the American Institute of Electrical Engineers will be held in the Engineering Societies Building on Feb. 11 under the auspices of the telegraph and telephone committee. Mr. W. Lee Campbell will present a paper entitled "Modern Automatic Telephone Apparatus." On March 11 a joint meeting will be held with the Institute of Mining Engineers. Papers on electric mine hoists will be read by Messrs. D. B. Rushmore and W. Sykes; Mr. R. R. Seeber will present a paper entitled "Electric Mine Hoists with Ilgner Motor-Generator Set," and a paper giving a comparison of electric and compressed-air drives for mine hoists will be read by Mr. K. A. Pauly.

A meeting of the Institute in co-operation with the American Society of Mechanical Engineers will be held in Boston on Feb. 16 at the Boston City Club. Papers relating to the industrial application of electric motors will be read by Messrs. D. C. Jackson, C. T. Main and W. S. Nye. Mr. G. H. Stickney will present a paper entitled "Illumination for Industrial Plants."

At the meeting of the Institute to be held on March 30, 31 and April 1 at Charlotte, N. C., the following papers will be read: "Economics of Hydroelectric Plants," by Mr. W. S. Lee; "Electric Drive in Textile Mills," by Mr. A. Milmow; "Gas Engines in City Railway and Lighting Service," by Prof. E. D. Latta, Jr., and "A Method of Protecting Insulators from

Lightning and Power Arc Effects with Results of Its Installation on the Lines of the Niagara & Lockport Power Company," by Mr. L. C. Nicholson.

Among the papers promised for a meeting of the Institute to be held on April 21 in San Francisco are the following: "The Economics of a General Power System," by Mr. John A. Britton; "The Developed High-Tension Network of a General Power System," by Mr. Paul M. Downing; "Hydroelectric Developments and Irrigation," by Mr. J. C. Hays.

Arrangements have been completed for the annual dinner of the Institute which will be held at the Hotel Astor, New York, on Feb. 24. The Edison Medal will be presented to Prof. Elihu Thomson, the guest of honor at the dinner, for "meritorious achievement" in electrical science, engineering and arts, as exemplified in his contributions thereto during the past 30 years.

Annual Meeting of the Western Electric Company.

Being an Illinois corporation, the Western Electric Company held its annual meeting in Chicago, the date being Feb. 3. Directors were elected by the stockholders as follows: Messrs. E. M. Barton, Henry S. Howe, A. D. Wheeler, H. B. Thayer, Theodore N. Vail, John I. Waterbury, W. H. Miner, E. J. Hall, F. R. Welles, S. L. Schoonmaker, B. E. Sunny and C. G. DuBois.

At the meeting of the directors, held on the same day, the following officers were elected: Chairman of board of directors, Mr. E. M. Barton; president, Mr. H. B. Thayer; vice-president, Mr. H. A. Halligan; vice-president, Mr. F. R. Welles; vice-president, Mr. W. P. Sidley; secretary, Mr. G. C. Pratt; assistant secretary and assistant treasurer, Mr. R. E. McEwen; treasurer, Mr. J. W. Johnston; assistant treasurer, Mr. E. R. Gilmore; assistant treasurer, Mr. J. B. Forbes.

The annual report of President H. B. Thayer, of New York, showed an excellent increase in the business of the company for 1909 as compared with the preceding year. The transfer of the power-apparatus business to the General Electric Company was also announced. The company's sales for the fiscal year ending Nov. 30, 1909, were $45,575,000, as compared with $32,314,000 for the previous year, an increase of 41 per cent. This increase in the volume of sales compares favorably with the increase for the same period of large enterprises in this country and has been well distributed over its different lines of merchandise and among the various classes of customers.

During the year an aggressive sales campaign has been carried on, which has resulted in a large increase in the number of orders and in the number of new customers. For 1909 the number of orders received in America was 695,000, as compared with 572,000 for 1908, and the value of an order for 1909 was $62, as compared with about $47 for 1908.

The net earnings for the year, after deductions for depreciation on plant and merchandise and interest paid ($280,000), were $2,089,000, which is 13.9 per cent on the capital stock. Dividends to the amount of $1,200,000 were paid from these earnings, and the balance was added to the surplus, making the book value of the capital stock $216.24 per share.

The total current assets, including sundry investments, at Dec. 1, 1909, were $30,781,000, which is more than 3½ times the total current liabilities.

A further increase in sales is expected for 1910. To finance this expanding business and pay off its present floating debt the company has issued $5,000,000 two-year, 4½ per cent collateral trust notes secured by $6,250,000 of its first-mortgage 5 per cent bonds, and it has also sold $8,750,000 of these first-mortgage bonds. It is expected that these funds will liquidate the floating debt and take care of the expected growth in the business in the immediate future.

Much progress has been made in concentrating the manufacturing work at the Hawthorn plant formerly carried on at the New York City and Clinton Street (Chicago) plants. The principal increases in plants during 1909 have been the completion and equipment of additions to the telephone-apparatus shops at Hawthorn. Offers have been made to the company for its Clinton Street and Polk Street properties, but none of them has been accepted because of unsatisfactory price or terms of sale. It is believed that eventually the company should be able to obtain a fair price for these properties, located as they are in such a growing center as Chicago.

The report states that it seemed best to discontinue the manufacture of power apparatus, both because of the growing demand for capital to keep up with the growth of the power-apparatus business, and because the increased demand for telephonic apparatus points to a greater need for capital for that purpose. The company, therefore, sold its patents, tools and patterns used in the manufacture of machinery for power and lighting to the General Electric Company. The company, however, will continue to sell a complete line of power and lighting apparatus to fill the demands of its customers.

On Dec. 1, 1909, the number of employees was 17,848, as compared with 14,449 on Dec. 1, 1908.

Keokuk Hydroelectric Development.

Preparatory construction work was begun Jan. 10 on a large dam to be built across the Mississippi River between Keokuk, Ia., and Hamilton, Ill. The site of the dam is at the foot of the Des Moines rapids, the power house being located a few blocks northwest of the river end of Main Street, Keokuk.

For years such a project has been talked of, but nothing definite, or at least of record, was done until the spring of 1899, when the late Charles P. Birge, of Keokuk, called a meeting of certain representative citizens from both sides of the river and formed the Keokuk & Hamilton Water Power Company. Money was subscribed, and Mr. Lyman E. Cooley, a consulting engineer of Chicago, was retained to make a preliminary investigation. Mr. Cooley's report was to the effect that while a wing dam, built along the Illinois shore, as had been proposed, was practicable enough from an engineering standpoint, it would not be a paying proposition commercially. Therefore this plan was abandoned.

The company was incorporated under the laws of Illinois, April 27, 1900. It was decided that the simplest and most direct plan would be to build a dam entirely across the river at the foot of the rapids. The company proceeded to acquire the necessary rights, make preliminary investigations, gather and publish trustworthy data and information, and in general to bring the proposition to the attention of men who might be persuaded to undertake the financing of it.

When incorporated the officers were as follows: President, Hon. John N. Irwin, Keokuk; vice-presidents, Mr. A. E. Johnstone, Keokuk; Mr. C. P. Dadant, Hamilton; secretary-treasurer, Mr. R. R. Wallace, Hamilton.

The company as organized proceeded to push the development, but without any marked effect until 1905. The attention of the late Col. B. F. Marsh, Illinois representative from the district including Hamilton, was then secured, and upon investigation he decided to undertake the passage of a bill by Congress authorizing the construction of the proposed dam. Such a bill was introduced, passed with the usual formalities, and approved Feb. 9, 1905.

In substance, the act simply granted permission "to the Keokuk & Hamilton Water Power Company, a corporation created and organized under the laws of the State of Illinois, its successors and assigns, to erect, construct, operate and maintain a dam, with its crest at an elevation of from 30 ft. to 35 ft. above standard low water, across the Mississippi River at or near the foot of the Des Moines rapids, from Keokuk, Iowa, to Hamilton, Ill., and to construct, operate, and maintain power stations on or in connection with said dam, with suitable accessories for the development of water-power, and the generation, use, and transmission therefrom of electric energy to be derived from the Des Moines rapids on the Mississippi River: Provided, That in lieu of the three locks and drydock,

with their appurtenances, now owned and operated by the United States at the Des Moines Rapids Canal, the said Keokuk & Hamilton Water Power Company shall build, coincident with the construction of the said dam and appurtenances, at locations approved by the Secretary of War, a lock and drydock, with their appurtenances; * * *"

Continuing, the act provides for the supervision and approval of all plans by the War Department, the Government paying the cost of its own supervision. A time limit was set upon the period which may elapse before beginning work, as follows: " * * * this act shall be null and void if actual construction of the works herein authorized be not commenced within five years and completed within ten years of the date hereof."

It is thus seen that when the construction work was begun, on Jan. 10, 1910, the limit granted by the act had less than a month to run.

During the spring and summer of 1905 the proposition was brought to the attention of Mr. Hugh L. Cooper, the consulting engineer, of New York City, who became interested and appeared in Keokuk to make investigations on his own responsibility. Meanwhile a committee of four, Messrs. Irwin, Logan, Johnstone and Dadant, had been appointed by the company to carry out negotiations for disposing of the energy. Mr. Cooper met this committee, and on Sept. 15, 1905, entered into a contract with the company. The business of furthering the project was renewed, both in the line of further investigation and in interesting possible capital. During the ensuing two years, for which period the contract was drawn, Mr. Cooper made most of the necessary preliminary surveys, chiefly for determining what lands would be overflowed. Little else was done meanwhile, except the passage by Congress of an amendment to an act authorizing the condemnation of lands needed for river and harbor improvement. This amendment required the Attorney-General, at the request of the Secretary of War, to conduct legal proceedings looking to such condemnation, the expenses of the procedure to be paid by the corporation in whose behalf it is carried on.

Not having been able to secure promise of the necessary capital by 1907, the panic of that year made the outlook discouraging. The Keokuk & Hamilton Company then extended its contract with Mr. Cooper another year. When this year had also passed and the necessary money was not in sight Mr. Cooper's contract was extended to Feb. 1 1910.

A few months after this last extension was made, the probable success of the enterprise began to be evident, and Mr. Cooper proposed to the existing company to take over all its rights. This proposition was accepted the consideration agreed upon and the transfer made Oct. 26, 1908. Thus the original company was dissolved.

It should be understood that the purpose of this company was not at any time actually to build the dam itself, as it could by no possibility have commanded the necessary capital. It was simply to clear the path and promote the whole scheme, until capital could be induced to take it up. This result being practically accomplished, there was no further need for its existence. In the new company formed only one local man, Judge Logan, of Keokuk, was retained.

Mr. Cooper pushed with vigor the business of enlisting capital and on Jan. 8 made the announcement of the favorable decision on the part of his investors. Work was at once begun and at the present time is well under way having proceeded rapidly.

Central-Station Plant at Evansville, Ind.

About April 1 work will be begun on the construction of the new electric central-station and steam and hot-water heating plant of the new Evansville Public Service Company, of Evansville, Ind. The company has a 25-year franchise and has purchased ground for its power house on the corner of Fifth and Mulberry streets, extending 85 ft. on the former and 120 ft. on the latter. The power-house building will be erected on the corner and space will be left for future extensions and also for coal storage and the erection of a cooling tower to be used in the summer when the plant will be run condensing. In winter the exhaust steam will be used for heating purposes.

About 2400 hp in water-tube boilers will be installed, and all the boiler-room auxiliaries of a modern electrical generating station will be required, including coal and ash-handling machinery. Steam turbines will probably be used and the initial equipment will undoubtedly consist of two turbo-alternators of 1000 kw each. A 25-ton overhead electrically operated traveling crane will be placed in the engine-room. Electricity will be supplied for all commercial purposes throughout the city, and steam heating will be sold in the business section and hot-water heating in the best portion of the residence section. The electrical distribution will be placed underground in the business district and carried overhead in the remaining portion of the city.

The initial installation will cost about $850,000, including the land, buildings, power-house and distributing equipment for both electrical and heating systems. A railroad track will be laid on the power-house site and coal will be delivered in carload lots on the premises. A feature will be made of installing all machinery parts in the power house in duplicate to insure continuous service. A trouble station will be built beside the power house, and here there will be two trouble wagons with operating crews and horses ready for instant service, as in the case of a fire-engine house, so that the apparatus will be ready to respond to trouble calls instantly at any time during the night or day. The Central Station Engineering Company, of Chicago, is the designing engineer. No contracts for machinery have been awarded as yet.

Maryland Public Utility Bill.

The Maryland public utilities bill drafted by Attorney-General Isaac L. Straus is now before the House in that State. This is the only bill on the subject which has been introduced in spite of the rumors that several would be presented. It is expected that the judiciary committee, which has the bill in charge, will begin hearings during the early part of next week and every effort will be made to have it reported as soon as possible. Both political parties are pledged to the passage of a public-utilities act applicable to all public-service corporations. Whether or not the Republicans will introduce a bill or support the Democratic measure now before the Legislature has not yet been decided. With both parties pledged to this measure, the feeling at the State House is that a public-utilities act will surely pass, but fears are being expressed by advocates of a public-utilities commission that the bill may be so amended as to render it practically ineffective.

Ohio Independent Telephone Situation.

An amended petition has been filed in the action brought in Cleveland some weeks ago to restrain the Cleveland Trust Company from transferring the stock of the Cuyahoga Telephone Company to the Bell interests, in which J. P. Morgan & Company and R. L. Day & Company, of New York, are made parties defendant. A receiver is also asked in the suit brought by Mr. J. W. Ott, one of the minor stockholders. This action followed the visit of Mr. Harrison B. McGraw, attorney for the minority stockholders, to New York for a conference with the members of the firm of J. P. Morgan & Company and the officers of the American Telephone & Telegraph Company.

In the amended petition, the court is asked to require J. P. Morgan & Company and R. L. Day & Company to set forth what interests they have in the stock and voting certificates of the Cuyahoga Telephone Company and further it is asked that the American Telephone & Telegraph Company be restrained from purchasing the stock of the company held by these two firms and that they be restrained from selling. The petition further charges that the purchase of the stock by R. L. Day & Company was made to conceal the name of the real purchaser, claimed to be the American Telephone & Telegraph Company,

and that if it was purchased for the account of J. P. Morgan & Company the transaction was made in this manner to prevent competition. Mr. James S. Brailey, Jr., J. P. Morgan & Company and R. L. Day & Company are asked in the petition as to what interests they have in, and the negotiations they have had with the American Telephone & Telegraph Company preparatory to selling the Cuyahoga Telephone stock.

In Toledo, it is claimed, evidences that there is some connection between the Bell interests and the independent companies are beginning to crop out. Some time ago the Bell company had many solicitors at work and telephones would be installed in residences with the promise of free service indefinitely. It is claimed that people who took service on these conditions are being notified to pay, the same as others, or telephones will be removed. This is taken as an indication that the company has ceased endeavoring to secure business in competition with the independents.

Toledo people believe that the companies will be operated as separate organizations for some time to come, however, as the income will be reduced by the removal of instruments if the companies and systems were combined. Then, this would give the independents an opportunity to install a new system in competition with the Bell interests, it is argued. There are many other reasons for keeping the two companies intact, they say.

The installation of telephone instruments of the Bell companies in the offices of the independents and vice versa is said to be for the good of the service of both. This has been done in several cities of the State, including Columbus, Toledo and Cleveland. Complaints may be made easily by this means when one or the other of the lines is out of repair. Other business reasons are given for this.

By the appointment of Mr. Gansey R. Johnson, manager of the Columbus Citizens' Telephone Company, as general manager of the Morgan interests in Ohio, outside of Toledo, Dayton and Cleveland, his authority has been extended over 13 distinct properties, as follows: The Columbus Citizens' Telephone Company, London Home Telephone Company, Franklin County Telephone Company, Washington Home Telephone Company, Citizens' Telephone & Messenger Company, Columbiana County Telephone Company, Findlay Home Telephone Company, Lancaster Telephone Company, Massillon Telephone Company, Starke County Telephone Company, Youngstown Telephone Company, Zanesville Telephone Company, and United States Telephone Company. The authority of some of the other officers of the Citizens' Telephone Company of Columbus has also been extended to cover these companies. Mr. J. C. Bousch, formerly general manager of the United States Telephone Company, will remain as manager of the company, with headquarters in Columbus.

Officers of the Cuyahoga Light Company, which refused a franchise granted it under the Johnson administration at Cleveland, is arranging to ask the new administration for a grant that will be in keeping with the necessities of the service. President J. George Kaelber, of Rochester, N. Y., was in Cleveland a few days ago, and the matter was talked over with the local officers. They expressed confidence that the Baehr administration would be perfectly fair with them in the matter of a grant. Secretary J. D. Lloyd stated that as soon as the weather will permit the lighting and heating will be extended on Euclid Avenue from East Third to East Ninth street and on some of the other thoroughfares in the business district.

Annual Meeting of Chicago Electric Club.

General felicitations on the success of the organization and the work of the officers were the order of the day at the annual meeting of the Electric Club of Chicago on Feb. 2. Nearly everybody present had something pleasant to say about everybody else. Mr. J. G. Pomeroy announced that in about three weeks the club will meet upstairs in the new annex of the Chicago Automobile Club. Mr. F. S. Hickok reported from the speakers' committee, making graceful reference to what the other members of the committee had done, but modestly refraining from dilating on his own work, which has been most important for the success of the club, inasmuch as about 40 different speakers must be provided for weekly meetings during the year. At Mr. Hickok's suggestion, the thanks of the club were extended to the Guarantee Electric Company for its courtesy in mailing the club notices every week without charge. Mr. S. F. Dibble, from the finance committee, spoke highly of the work of Treasurer Pomeroy. On relinquishing his office as president, Mr. F. P. Vose praised the work of the chairmen of committees, especially Mr. Hickok. Thanks were also expressed for the co-operation of the technical and city press. Mr. Vose pointed out the value of the club not only as a means of technical advancement, but also for its social relaxation—a feature which is much appreciated in the strain and turmoil of modern business life.

Mr. C. A. S. Howlett, former president, who had much to do with the formation of the club, presided during the election of officers, which was accomplished with much formality, although there was only one ticket in the field. The new officers are: President, Mr. Frederic P. Vose; vice-chairman, Mr. Homer E. Niesz; secretary, Mr. F. S. Hickok; treasurer, Mr. F. J. Postel. These gentlemen are members of the board of managers, the remaining members of the board being Messrs. A. A. Gray, W. E. Keily, Robert S. Mitten, George H. Porter and E. R. Rockwell.

Mr. W. S. Taussig, the retiring secretary, reported an average attendance of 61 at the meetings of the year. A vote of thanks was extended to the retiring officers, and Mr. Vose, on behalf of the new officers, thanked the members for the honor conferred. Mr. E. F. Kirkpatrick spoke of the good work of President Vose, who accepted the presidency on the retirement of Mr. Howlett and has been a tower of strength to the club. Mr. Perry R. Boole, who styled himself the chairman of the moral uplift committee, made some humorous remarks in which he congratulated the members on a distinct improvement in their character and habits. Mr. Niesz spoke of the success of the recent Chicago Electrical Show, and Mr. Gray, who had previously reported from the house committee, praised the work of Messrs. Taussig and Pomeroy, the retiring secretary and retiring treasurer. Both of these gentlemen also spoke briefly, the former alluding to the singular unity of purpose in the club. Before adjournment, Mr. Vose also thanked Mr. Gray for helpful work for the club performed on several occasions.

Federal Control of Water-Power.

A section of the preliminary report of the United States Natural Waterways Commission, which was presented to Congress on Jan. 24 and just issued in printed form, contains a section on the use of water-power in connection with the development of navigation, as well as plans for the utilization of power and the right of the Government to control the same.

The Commission states that, while the subject of water-power is not within the scope of its inquiries, yet the members have given much attention to this general subject and strongly recommended the greatest care in the conservation of water-power for the use of the people. Its value has not been fully understood, and power derived from navigable and non-navigable streams will undoubtedly be developed to a much greater extent in the future and for a larger variety of uses. The Commission especially recommends such legislation by Congress and by the States as would prevent monopoly in the possession of water-power, and secure, to the greatest possible degree, its utilization for the general benefit.

The rights of the Federal Government in water-power may, it states, be viewed from three different standpoints:

First. Cases in which power is developed on streams located in public lands, where undoubtedly the Government, so far as the rights pertaining to abutting ownership are involved, has full control, and should exercise the greatest care in granting away whatever rights it may have.

Second. When power is developed in non-navigable streams, where there is private or State ownership, in which case no

ner in which the underwriters are related to the electrical industries of the country.

There are at times local frictions, and inspectors are not always perfect any more than contractors and service-company officials, but the sum total of the efforts of the underwriters to reduce the electrical fire hazard has been to advance the safety and permanency of electric wiring to a point where the general satisfaction of the public makes a constantly increasing demand for wiring and for energy in electrical form.

Wireless Telegraphy.

At a meeting of the Wireless Institute, held in the Engineering Societies Building, New York, on Feb. 2, Mr. A. R. Sharples presented a paper entitled: "Resistance in an Oscillating-Current Circuit." The author stated that, in an oscillating circuit, resistance appears at four points, namely, the metallic conductor, the spark-gap, the ground and the detector. His remarks dealt largely with the resistance in the metallic circuit. When the resistance is expressed in ohms, the capacity in farads, the inductance in henrys, the oscillating frequency in cycles per second is

$$n = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{4L^2}}$$

When $R^2 \div 4L^2$ is equal to or greater than $1 \div LC$ the current ceases to be oscillating. Thus in an oscillating circuit R must always be less than $2\sqrt{L \div C}$. In any event the resistance should be kept small, because upon the value of the resistance depends the "damping" of the circuit or the rate at which oscillations decrease in amplitude by reason of the waste of energy.

The effective resistance of a circuit for high-frequency alternating current or oscillating current is much greater than that of the same conductor for direct current on account of the "skin effect." At very high frequencies, of the order of 1,000,000 cycles per second, the current penetrates to a practically constant depth quite independent of the diameter of the conductor. In a copper wire 0.625 in. in diameter the resistance for high-frequency oscillations is 62.5 times the resistance for direct current; in a wire 0.125 in. in diameter the ratio is 12.5; when the diameter is 0.0125 in. the ratio is 1.25, while with a diameter of 0.00125 the ratio is 1,00006. It will be noted that for the larger diameters the high-frequency oscillating current has an effective penetration of 0.01 in.

In making a ground connection it is desirable to render the resistance as small as possible. When difficulty is experienced in making a good metallic connection to the earth in moist soil use can be made of electrostatic capacity by spreading a large conducting area over the surface of the ground to act as one side of a condenser, of which the other side is the earth.

Automatic Telephony.

An instructive address on "Recent Developments in the Automatic Telephone" was delivered at a joint meeting of the Electrical Section of the Western Society of Engineers and the Chicago Section of the Western Society of Electrical Engineers, by Mr. Lee Campbell, at the rooms of the former society in Chicago on Jan. 26. Mr. Campbell is general superintendent of the Automatic Electric Company and he made an elaborate working exhibit of apparatus to be examined by his hearers in connection with his lecture. A section of an automatic switchboard was set up in the hall in a cabinet having glass doors, and scattered about the rooms were several automatic telephone stations, so that those who desired could themselves test the actual operation of the system. The apparatus shown was, of course, of the latest type. There was a good attendance, and perhaps particular interest was taken in the lecture because of the recent announcement that the Illinois Tunnel Company will rehabilitate and extend its automatic telephone service to compete actively with the Chicago Telephone Company in the local field. Mr. W. B. Jackson presided at the business meeting which preceded the address, but he turned the meeting over to Mr. J. G. Wray, chief engineer of the Chicago Telephone Company, who was called away before the close of the meeting, however, leaving Mr. Geo. H. Lukes, of the North Shore Electric Company, to preside.

Mr. Campbell gave a general idea of the elaborate automatic telephone equipment made by his company and also explained how it is used. He based his remarks on a series of lantern-slide pictures. One of the recent developments in automatic telephone apparatus is the introduction of the two-wire system, doing away with the ground connection. The ringing is done automatically by the use of this system. Beginning with the subscriber's instrument, the speaker explained the mechanism of the dial calling device and showed pictures of both desk and wall instruments. He said that private branch exchanges may be used with the automatic exchange, using automatic or manual instruments, or a combination of both. In the automatic system the connector switch largely takes the place of the operator of the manual system, and the construction and operation of this device were explained and illustrated. When the subscriber operates the dial calling device by moving the dial around to the "stop" position a certain number of times and certain distances according to the numbered finger-holes on the dial, the last two digits operate the connector switch; the use of the preceding digits operates selector switches, selecting the connector switch, which gives the final actual connection. It is found by experience that it is rare that more than 10 people in a given 100 telephone subscribers desire to make calls at the same instant. Mr. Campbell explained how the selectors give access to idle connector switches. He then described a "line switch," one of the comparatively new devices used with the automatic system, which simplifies the exchange equipment greatly by reducing the number of connector switches required.

Views were given of automatic telephone switchboards in a number of cities, both the older and more recent types being shown. A plan drawing was exhibited showing that a 10,000-line exchange may be placed in a room 75 x 53 ft. An important feature of the automatic system is the possibility it affords of doing away with a large portion of individual subscribers' lines, substituting trunk lines therefor by the use of what are termed "district stations." which are somewhat analogous to substations in light and power work. These district stations are employed in large telephone exchange systems. Twenty-three pairs of wires from the district station to the main exchange will serve 100 lines. This is a great help in doing away with idle-wire plant—a desideratum in telephony, for such idle plant represents enormous economic waste. Probably in the ordinary manual system not more than 8 per cent of the wire plant is in use at the busiest hour of the busiest day, but of course the capital charge of the remaining 92 per cent is equally as great as on the wire plant actually in use at any given time. The automatic engineers hope to carry the district station scheme to such an extent that there will be one of these substations for every group of 100 subscribers, thus relying on trunks as far as possible for connections, reducing the length of the individual subscriber's lines to the minimum. This arrangement has not been reached in practice, however. The speaker showed a picture of a 600-line district station building in Oakland, Cal., which is of particular interest because it is built entirely of discarded underground conduit. He also showed a handsome district station in Columbus, Ohio, placed in a fine residence section, and, although located at the back of a lot, made to conform to the general architectural surroundings.

After an intermission in which those present left their seats and examined the automatic apparatus on exhibition, opportunity was given for discussion. Mr. Charles A. Winston, chief engineer of the Kellogg Switchboard & Supply Company, said that it is the opinion of some engineers that a combination of the automatic and manual systems will eventually survive

Federal authority to regulate or control exists, except to prevent interference with the navigation of other streams.

Third. When water-power is developed in navigable streams. In this case several plans have been proposed for the collection of tolls upon the water-power developed by dams whenever their construction is permitted by Congress. The right of the Federal Government to collect such tolls must rest on one of three theories:

1. That the Federal Government has some proprietary right in the waters of navigable streams, so that the collection of tolls can be based upon actual ownership of, or right in, the waters.

2. That, as the right to grant or withhold consent for the construction of a dam in navigable waters rests in Congress, it is allowable to make a charge for the consent or privilege and authorize the collection of tolls.

3. That the Federal Government in its jurisdiction of interstate commerce has control of navigable streams and has a certain degree of responsibility for their improvement. Under this theory it is maintained that tolls upon the water-power developed can be collected and paid into a fund for the improvement of navigable streams, including not only the one on which the toll is charged, but all others capable of improvement for navigation.

The Commission is of the opinion that the Federal Government has no proprietary right or interest in navigable waters which would authorize the collection of tolls. The right, if it exists at all, rests upon either the second or third theory stated. As regards the second theory, it should be said that the imposition of tolls, unless based upon a more substantial foundation than the mere authority to grant or withhold consent—an authority arising solely from the control of the Federal Government for the purposes of navigation—does not commend itself to the Commission, and it is to be doubted whether, even in case a bill should be passed or other action taken by Congress for granting this permission, with a provision for charging tolls, such tolls could be collected. Regarding the third theory stated, it should be noted that under the exercise of the taxing power Congress can levy taxes for general revenue purposes upon all classes of water-power, whether in navigable or non-navigable streams, and if charges are to be imposed it would seem that this is the normal method. It should further be borne in mind that a requirement for the imposition of tolls where the right to construct dams is hereafter granted would cause a discrimination between water-power to be utilized under future permits and those already enjoyed, which are subject to no such charge. It must, of course, be remembered that whenever the privilege of constructing dams is granted in a navigable stream there is an undoubted right to impose charges sufficient to pay the expenses of examination and supervision and to secure the Government against cost by reason of obstacles to navigation created by the erection of dams; but this rests upon an entirely different principle from the proposal to charge tolls.

The control of the Federal Government over navigable streams has to do with navigation only, and in the exercise of this jurisdiction the plan commends itself to the Commission of inserting in each grant or franchise under which the consent to construct a dam is given a condition that the grantee who constructs the dam must also, whenever necessary to subserve the interests of navigation, construct a lock suited to the locality and to the probable development of traffic, and also furnish power for the proper operation of the lock or locks. These requirements, rather than the imposition of tolls, appeal to the Commission because they are free from legal objections and are in entire accordance with the objects for which the Federal Government has jurisdiction over navigable streams.

Whenever the Government constructs dams for purposes of navigation or irrigation, and, as an incident thereto, water-power is developed, such power should be utilized and an adequate charge made therefor.

The Commission would call attention also to another important step in the control of water-power, namely, that before the right to construct dams in any navigable stream is granted there should be a careful survey of the whole stream, or at least of that portion the regimen of which will be affected by the proposed construction. In the development of water-power there is danger that dams will be located or constructed in such a manner as not to accord with the most helpful development of navigation.

The Commission accordingly recommends that whenever permission to construct a dam in a navigable stream is requested consent shall not be granted until a survey has first been made and the proper location of dams has been determined.

It may also be stated that it is the opinion of the Commission that if constitutional authority therefor exists a provision should be inserted in these grants giving to the Secretary of War or other official the right to regulate charges for power furnished to consumers.

A provision reserving to Congress the right to alter, amend or repeal should be inserted in every act granting water-power rights.

Insurance Companies and Conservation of National Resources.

At a luncheon of the Colorado Electrical Club at the Albany Hotel, Denver, Feb. 3, a talk on conservation of natural resources "by insurance companies" was given by Mr. W. J. Canada, electrical engineer for the Rocky Mountain Fire Underwriters' Association.

The interest of the underwriters in electrical development was stated to be measured to a large extent by electrical fire losses throughout the country, amounting approximately to $15,000,000 annually. Considering that there are about 11,000,000 buildings in the country and some 8000 fires of greater or less extent annually attributed to electrical causes, if these fires involved total losses, there would be necessarily a uniform charge of 7 cents per $100 of insurance throughout the country to cover these losses, not including the expenses incurred in the distribution. This means a loss of something like 20 cents per capita; and when the electrical fire loss in this country is compared with the total loss of 30 cents per capita due to the causes in European countries, the national sin of carelessness appears strongly.

The speaker emphasized the enormous drain on the country's resources caused annually by a fire loss which would bankrupt any other country in the world, and developed the causes to which this loss may be attributed—flimsy construction, carelessness in use of matches and petroleum products, abuse of wiring, etc. The principal cause was given as the national carelessness, and it was stated that while foreign countries hold the individual whose carelessness brings about fire waste responsible for the loss to all his neighbors, in the United States, with every restriction thrown about the insurance companies, which simply distribute the loss over as wide a territory as possible, no effective restrictions are made on the fire waste itself, and individual responsibility is rarely placed for fire losses, which amount to 10 times the amounts in European countries.

The speaker stated that from the negligence of State and municipal governments, practically the entire work in reducing fire losses has been thrown upon the insurance companies. In their work of measuring the fire hazard these companies have, as a necessary method of properly distributing the annual tax of the fire waste, brought about improvements of every kind in fire departments, in water-works, in building ordinances and supervision, in the storage of combustible materials, and finally in bettering the grade and safeguarding against the hazard of electricity in every form.

Electricity utilized through wiring properly installed gives to-day the safest possible method of illumination and power distribution. This is largely due to the careful supervision of the underwriters or the municipalities whose supervision has been brought about by the underwriters. This is the practical man-

At present these cars are largely brought into Boston via Boylston Street, the principal business thoroughfare of the Back Bay, and one of the most heavily traversed streets in New England. The Boston Elevated Railway Company is at present pushing the construction of its Cambridge Subway, which will connect with the Park Street station at the Boston end of the line, and tend to reduce the present congestion on Boylston Street, although it is doubtful if the time of transit from the outlying suburbs will be much decreased by the removal of certain cars from the surface.

The Amesbury Electric Light Company has petitioned the Gas and Electric Light Commission for the right to issue new stock and bonds to the amount of $40,000, to pay floating indebtedness and for plant extensions.

Massachusetts Legislative Notes.

Hearings will shortly be given at Boston by the Legislative committee on public lighting upon various bills now in its custody in which private and municipal plants are interested. Eleven references have been made to this committee, and, in addition to the bills previously referred to in these columns, the list of subjects before the committee includes the regulation of charges for gas and electric meters, appeals to the Massachusetts Gas and Electric Light Commission and municipal plants. Among these later bills is one providing that no person, partnership or corporation furnishing electric energy for light, heat or power shall make any charge for furnishing meters or for their use. A similar bill has been introduced in reference to gas meters. Another bill authorizes any two or more manufacturers or merchants to unite and co-operate in economically supplying each other with electric energy upon receiving a permit from the local Board of Aldermen or Selectmen. This bill is regarded as one of a most sweeping character, and is an attempt to extend the principle of "block plant" supply of electricity to neighborhoods, involving the crossing of public and private ways and seriously menacing the ability of central stations to compete with isolated plant service. Under the present laws no isolated plant can cross a public way with its lines, and this bill is certain to rouse the united opposition of central station interests.

A bill has been introduced which provides that if the Mayor and Aldermen or the Selectmen of a municipality act adversely upon the request of a lighting company for a pole and wire location or fail to act within 60 days of the filing of the petition, the company or any interested party may file a petition for the location with the Board of Gas and Electric Light Commissioners, who shall, after due notice and public hearing, determine whether public necessity and convenience require the granting of the petition. The board is to specify the kind of construction and the location of the poles when granting such a petition. Any company aggrieved by the decision of the municipal authorities may appeal to the commission, whose decision is to be final. This bill places line locations of central stations under the supervision of the Gas and Electric Light Commission in much the same way that the location of electric railways is now under the final jurisdiction of the Railroad Commission. This arrangement has proved to be of the greatest value in cases where improvements of a broad and general public benefit have been held up by the provincialism or obstinacy of local town authorities.

A bill relating to the establishment of municipal lighting plants by cities provides that a city may acquire or establish such a plant after it has been so authorized by a vote of a majority of each branch of its City Council passed in any municipal year and thereafter ratified by a majority of the voters at an annual or special city election occurring not less than 60 days after the action of the Council. The intent of this bill is to abolish some of the most important safeguards which surround the central station and to facilitate the embarkation of cities in municipal lighting enterprises. Under the present laws a city cannot embark in municipal lighting without two successive yearly votes of a two-thirds majority of the City Council ratified by a majority of the voters at an annual or special city election. Another municipal lighting bill before the committee provides that any city or town may construct either gas or electric plants for its own or commercial service with practically no restrictions. The bill provides that when the municipality decides to establish such a plant it may take land by right of eminent domain, and it may receive from the owners of any private plant, in case there be one or more, the offer of a purchase price, or a board of appraisers may be appointed for guidance. The bill concludes with the naïve provision that nothing in it is to be construed as binding the city or town to purchase the private plant.

Wisconsin Rate Commission News.

The Wisconsin Rate Commission has handed down a decision in the case of the Columbus Advancement Association vs. the Wisconsin Telephone Company. The petitioners complained of discriminatory service, and that such a complaint was warrantable was clearly shown by testimony introduced at the hearing and by a special investigation conducted by the engineers of the commission. Aside from minor aggregations of the petitioners it was shown that the company has been listing certain parties at four-party rates, and by private agreement, furnishing them with three, two, or even single-party service. The investigation showed that out of 277 subscribers listed at four-party rates in February, 1909, only 48, or 17.3 per cent, were actually receiving four-party service. Twenty-nine subscribers were receiving single-party service at four-party rates, and 128 were receiving two-party service. In January, 1910, the service was somewhat better, and some improvement had been made toward the elimination of this incongruous situation. The commission recognizes the fact that, from a practical standpoint, it is impossible to keep lines filled up entirely, for this would undoubtedly involve costly and expensive bridging in the central office. Again, a too prompt filling up of party lines is often a short-sighted policy. Nevertheless, the commission feels that it is untenable that 72 per cent of the lines should have no more than two parties on a line, and that consequently about 57 per cent of the subscribers should be favored with two-party and single-party service when they are not paying for that service. It is a discriminatory practice and contrary to the rulings of the commission. The commission in its decision has ordered the Wisconsin Telephone Company to regroup those of its party-line subscribers who are now receiving a higher grade of service than that for which they have subscribed, by virtue of unfilled lines, in such a manner that as far as practical all party-line subscribers will receive the exact grade of service to which the rate they pay entitles them.

The petitioners in the above case allege also that the rates as charged by the Wisconsin Telephone Company are excessive. From data compiled by the engineers of the commission it appears that, if a 7 per cent rate be allowed for plant depreciation, the company has failed by $3,900 to earn a rate of return of 6 per cent per annum upon its investment during the past six years. This condition of affairs did not warrant a reduction in rates.

The Franksville Telephone Company has been given authority to increase its rates from $1 per month per subscriber to $1.25 per month. This rate is a tentative one, and is a compromise between the old rate and a $1.50 rate asked for by the petitioners. Whether it will prove satisfactory or not will depend upon whether the company is in a position to take on a considerable number of new subscribers without adding materially to its investment.

New York Public Service Commission News.

The Public Service Commission of the First District of New York held a hearing last week on the question of inadequate service in the subway. The results of investigations, made by engineers of the commission, were read, showing that express trains were found to be crowded in the non-rush hours of the

in telephone work. He described the semi-automatic and the auto-manual systems.

Mr. Campbell remarked that automatic switchboards are considerably more expensive than the manual boards in first cost, the saving being in operating costs. The semi-automatic system represents about the same first cost as the manual type, whereas the auto-manual system is about the same as the full automatic in first cost. It may prove that the combination of manual and automatic telephony may have all the defects of both systems without the advantages of either. Possibly, however, the purchaser of telephone equipment who cannot afford the full automatic apparatus or who has not sufficient faith in it to buy it may be induced to use the semi-automatic apparatus.

Mr. A. M. Haubrich, of the Stromberg-Carlson Telephone Manufacturing Company, favors the manual equipment, or, possibly, in some places, the semi-automatic. There are so many manual switchboards in use in the country that it would be a very serious question whether they should be thrown out, even if the automatic claim to better operating results were generally conceded. Where multiple manual boards are loaded to their full capacity, semi-automatic extensions may be added perhaps. Mr. Haubrich is doubtful if the full automatic system will ever supersede manual operation. The telephone company should do the operating in full itself; it should not ask the subscriber to do this work.

Mr. F. F. Fowle said that to his mind one of the most important and promising features of the automatic system is the saving of subscribers' lines by the possibilities of the substation system. In manual systems the cable plant may represent three-quarters of the entire investment. To offset the saving which the automatic apparatus offers in this direction, the increased cost of the automatic equipment must be considered, but the great possibilities in the saving of wire in individual subscribers' lines must remain one of the great factors in introducing the automatic apparatus. It is also possible to study traffic conditions better where the automatic system is used. On the whole, this speaker appeared rather to favor the automatic type of equipment.

Mr. T. E. Meyer, of the Automatic Electric Company, spoke of the customer's satisfaction in using the automatic service.

Mr. M. L. Johnson, of the same company, spoke of some incidental features of telephone operation. For instance, in testing lines where the automatic apparatus is used, there is no human element to contend with. The tester has absolute control of the line under test. Mr. Johnson also referred to toll-line service, to which the automatic equipment may be readily adapted. "The more you go into it," he said, "the more fascinating the automatic becomes in all the by-ways of telephone service."

Mr. A. Miller Belfield, patent lawyer, saw no reason why the telephone business should not follow all other industries in the increased use of automatic machinery. Messrs. E. N. Lake, A. Bement and others spoke briefly.

Closing the discussion and answering some questions that had been asked, Mr. Campbell said that the exchange rates charged in cities where the district stations are used in connection with automatic telephone systems are about the same as prevail generally in telephone exchange service. As to depreciation on automatic equipment, no exact figure can be given at present. The parts of the automatic switchboard which wear out most quickly are generally inexpensive. Mr. Campbell believes that the depreciation on an automatic switchboard is less than on a manual board. Referring to private branch exchange work, the speaker said that a telephone operator may be retained in the subscriber's office if desired, to save the time of the men in that office. If it is desired to make a succession of calls from one instrument, either a single instrument or one attached to a private branch exchange, the work can be done more rapidly by the automatic system than where operators are employed. Any number of trunks can be used under the one number shown in the telephone directory, the automatic system selecting an idle trunk.

Byllesby Engineering Convention.

The first semi-annual convention of H. M. Byllesby & Company was held in the Congress Hotel, Chicago, last month. It was a three-day convention and about 300 persons attended, including field managers and superintendents, Chicago office men and associates of the company in the 30 or more public-utility properties which the company owns and operates in various parts of the country. There were morning, afternoon and evening sessions, and an arrangement was made with the hotel people whereby the Italian Room was given over entirely to the use of the convention. A portion of this room was screened off, and here luncheons and dinners were served, so that no time was lost in leaving the hotel for meals. Mr. H. M. Byllesby delivered the address of welcome and Mr. A. S. Huey was elected chairman.

Papers and addresses were delivered as follows: "The Legal Department," Mr. Frederick W. Stearns; "Accounting and Distribution," Mr. John J. O'Brien; "Investment Club," Mr. Robert J. Graf; "Power-House Construction and Economic Operation," Mr. H. Boyd Brydon; "Successful Utility Management," Mr. Arthur S. Huey; "Securities," Mr. R. E. Wilsey; "New Business," Mr. Errett L. Callahan; "Manufacture and Distribution of Electricity," Mr. Harold Almert; "Central-Station Heating," Mr. William F. Raber; "Commercial Value of Water-Powers," Mr. Otto E. Osthoff; "Street-Railway Operation," Mr. J. Walter Gillette; "Gas Manufacture and Distribution," Mr. Robert G. Hunt.

The titles of these papers indicate clearly the varied scope of the company's activities. Opportunity was afforded for discussion after every paper, and the evening smokers were of a more informal nature. On the afternoon of the closing day the visitors were taken for an inspection trip to the Fisk Street Station of the Commonwealth Edison Company, and the convention closed with a formal banquet at Congress Hotel. Mr. Byllesby presided at this gathering, with Mr. C. A. Coffin, president of the General Electric Company, on his right, and Mr. Samuel Insull, president of the Commonwealth Edison Company, on his left. Other gentlemen at the speakers' table included Messrs. B. E. Sunny, Charles G. Dawes, Rufus Dawes, L. A. Ferguson, John J. Abbott, George B. Caldwell, Clarence Buckingham and A. Urlaub, all of Chicago, as well as Mr. Dennis B. Flynn, of Oklahoma City, and Mr. Warrington G. Lawrence, of New York. Gen. Frederick D. Grant was one of the guests. Speeches were made by a number of the distinguished visitors. The convention was a most successful one in every way. The next one will be held in July in Tacoma with Mr. Tidnam as chairman. Fort Smith, Ark., and Oklahoma City were active candidates for this convention, but Tacoma won by three votes.

Massachusetts Commission News.

The Boston Transit Commission recently gave a public hearing in regard to the desirability of the early construction of the so-called Riverbank Subway, which is designed to connect the Park Street district with the outer Back Bay, coming to the surface near the intersection of Beacon Street and Commonwealth Avenue. The law providing for the construction of this subway authorizes the Boston Elevated Railway Company to accept the act a year or more after the completion of the Washington Street tunnel, and so far the company has not taken steps in this direction. At the hearing a large number of prominent residents of the Back Bay urged the Commission to recommend the immediate construction of this subway. The company was not represented. It is contended that the cost of this subway would be extremely moderate in comparison with the expense of recent underground lines in Boston, on account of the absence of difficulties induced by high buildings and narrow streets. The subway would follow the south bank of the Charles River after leaving Beacon Hill, and would materially shorten the running time of surface cars operated between Allston, Brighton, Brookline, Newton and the center of the city.

day and that the overload was very serious from 4 to 7 o'clock in the evening. The highest number of trains that passed over a single track in any one hour was 32, and the highest number in any half hour was 17. Frank Hedley, general manager of the Interborough Rapid Transit Company, said that express trains during the rush hours were operated at a headway of one minute and 48 seconds, and that he believed that when all of the new side-door cars had been received they could be run on a headway of one minute and 30 seconds. He said that the company had ordered 250 new cars during the past year, but that only 45 of them had been delivered owing to delays on the part of the manufacturers. He did not expect the express service to be fully equipped before the first of next year.

Senator Harden has introduced a bill in the Senate at Albany amending the rapid transit act so that no plan for subway extension can be adopted by the Public Service Commission unless it includes certain named routes in Williamsburg and Long Island City.

The Board of Estimate and Apportionment has received applications from five traction companies for temporary permits to operate cars across the new Manhattan Bridge. These applications are from the Metropolitan, Third Avenue, Brooklyn Heights, Nassau Electric and Coney Island & Brooklyn companies. All of the applicants offer to sell bridge tickets at 3 cents or two for 5 cents.

A hearing was held last week by the Board of Estimate upon the application of the Manhattan Bridge Three-cent Line for a franchise over the new structure. It is proposed to run the line from the Hudson River, through Canal Street, across the bridge and to the Long Island Railroad station at Atlantic Avenue. The length of the line will be about five miles and the fare 3 cents. Representatives of the Brooklyn Rapid Transit Company appeared to oppose the application, and declared that their company had made similar applications several months ago which had not as yet been acted upon. Action on the matter was postponed.

At the hearing of the Legislative Committee last week into the affairs of the telephone and telegraph companies, Union N. Bethell, vice-president of the New York Telephone Company, and Howard F. Thurber, its general manager, testified as to telephone rates in the metropolitan district. Mr. Thurber said that the rates were as low as it was possible to make them and continue to earn a profit, and that they were largely based on the density of population. He said that it was necessary to establish zones in which fixed charges were made, and for that reason calls were made 5 cents in Manhattan and 10 cents in the Bronx and Brooklyn. He said that a reduction of these 10-cent rates would seriously affect the company's dividends. He explained the recent reduction in certain suburban rates by saying that the increase in business from these points made the reductions permissible. Mr. Bethell said that it cost more to carry a man's voice over a certain distance than to carry his person because when a man telephoned he had the exclusive use of the apparatus. He also said that many protests had been received from business men against the installation of two telephone systems in the same city. The committee brought out the fact that the big hotels pay the company 3 cents a call and charge their patrons 10 cents.

The Public Service Commission, Second District, has authorized the Elmira Water, Light & Railroad Company to acquire all the capital stock of the Montour Falls Electric Light Company and to issue $20,000 consolidated mortgage 5 per cent, 50-year gold bonds for the purpose of acquiring this capital stock. The company is also authorized to exercise franchises in the towns of Horseheads and Veteran, Chemung County, and Montour, Schuyler County, for the purposes of distributing electricity in these towns and for transmitting electrical power through these towns to Montour Falls. The company is also authorized to extend its lines in the towns of Southport and Elmira, Chemung County, franchises having been granted by these towns.

The North Creek Electric Company of North Creek, Warren County, has been authorized to exercise franchises granted in the town of Johnsburg for the purposes of furnishing and distributing electricity in this town. The company is also authorized to issue bonds to the amount of $20,000, the proceeds to be used for the construction of the necessary plant and purchase of land in connection therewith.

Canadian Hydroelectric Commission News.

The American section of the International Waterways Commission, sitting at Buffalo, recently reported favorably upon the company's proposed undertaking to construct a large dam on the St. Lawrence River at Long Sault Rapids below Cornwall. It is reported, however, that the Government of the Province of Ontario will strenuously oppose the scheme when the matter comes before the Canadian section of the Waterways Commission for consideration.

Hon. Adam Beck, chairman of the Hydroelectric Power Commission, will present the claims of the Province of Ontario. While none of the cabinet ministers will make any statements, it is understood that the application involves the question of provincial rights.

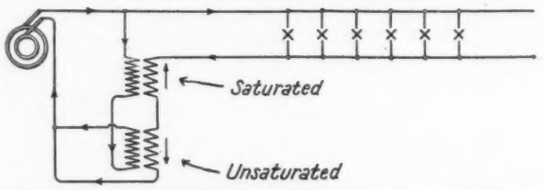
It is further alleged that the St. Lawrence Power Company is being engineered by Pittsburgh capitalists, who desire that a power plant be established on the Canadian side, from which power could be exported into the United States for manufacturing purposes.

It is understood that the Provincial Government will offer opposition to the plans of the company until some provision is inserted in the proposed charter for the control of power, both as to the quantity that shall be exported and the price charged for it. It is desired to place the whole matter under the authority of the Hydroelectric Power Commission and the Railway Commission.

The Canadian Marine Association has announced that it will oppose any project for damming either the St. Lawrence or any of the canals.

Compounding Alternating-Current Circuits.

A simple method of providing for the regulation of alternating-current circuits under conditions of varying load is proposed in a recent patent granted to Mr. William Stanley. As shown in the accompanying sketch, use is made of two transformers having their primaries connected in series with each other and in shunt to the source of voltage of the circuit, and their secondaries connected in series with each other and the load. The resultant voltage at the load is thus made up of the generator voltage and that produced in the transformer secondaries. One of the transformers has its core so proportioned as to be saturated, while the other is unsaturated. Their corresponding primary terminals are also reversed, so that at no-load the induced voltages are equal and in opposition. As the current in the load circuit is increased, the magnetization in the saturated transformer core remains unaffected, while that in the unsaturated core is correspondingly increased. This increases the secondary voltage which is in the direction to add to that of the source, increasing the voltage applied to the load. The boosting effect thus supplied by this arrangement of transformers varies with the demand made by the load, and compensates for the voltage drop in the generator, transmission circuit, transformers, etc.



Arrangement for Compounding Alternating-Current Circuits.

CURRENT NEWS AND NOTES.

Chemical Research.—A gift of $50,000 for a laboratory of chemical research for Cornell University has been received from the Hon. Andrew White.

Factory Lighting.—At a meeting of the New England Section of the Illuminating Engineering Society, to be held in Boston on Feb. 11, a paper entitled "Factory Lighting" will be presented by Mr. L. B. Marks. The meeting will be preceded by an informal dinner at the Boylston Café, beginning at 6 o'clock.

Southwestern Electrical and Gas Association.—Beaumont, Tex., will be the next place of meeting of the Southwestern Electrical and Gas Association. The annual convention will be held at some date in May, which has not yet been fixed. Mr. W. B. Head, of Stephenville, Tex., is president of the association, and Mr. Edward T. Moore, of 300 Commerce Street, Dallas, Tex., is secretary.

Opposition to Locomotive Lighting Legislation.—The Baltimore & Ohio Railroad has filed a bill against the Indiana State Railroad Commission, asking an injunction against the rule requiring railroads to equip locomotives with 1500-cp headlamps. The railroad contends that a lamp of such a candlepower would obliterate signals owing to their intense light and that when thrown into the eyes of men on passing trains would blind them temporarily.

N. E. L. A. Convention Commercial Program.—The Commercial Day Program committee of the National Electric Light Association met as the guests of H. M. Byllesby & Company, Chicago, on Jan. 20. It was planned to have not over 10 papers on the program and of these several will discuss other matters than soliciting of new business and advertising of electric service. The final meeting of the committee is set for Mar. 17, at which time a complete program will be arranged.

Removal of Projecting Signs.—By the provisions of a city ordinance in Chicago the Mayor has authority to order the removal of electric signs projecting over the sidewalks on any street where the abutting property owners request him to do so by petition. This has been done on State Street, and now an order has been issued for a similar removal of the projecting signs on Madison Street between the Chicago River and Lake Michigan. The objection to the projecting electric signs is on the ground that they are inartistic. Signs placed flat on buildings are allowed to remain.

Proposed International Municipal Exposition in Chicago.—Acting on the suggestion of the Chicago Association of Commerce, the Mayor of Chicago has recommended and the City Council has approved a plan for the holding of an international municipal exposition and congress in Chicago in the fall of 1911. The proposed gathering will take particular cognizance of the widespread movement now in existence having for its object the improvement of cities and making them more healthful, sensible and attractive places to live in, as is exemplified by the "Plan for Chicago" of the Commercial Club of that city.

"Wireless" on the Isthmus.—On Dec. 31 last the first message from the new wireless station at Porto Bello was received at the Colon station, Isthmus of Panama. Since that date a large amount of business for the Isthmian Canal Commission has been transacted regularly through the Colon station, the distance being about 17 miles. DeForest apparatus is used, and when the final equipment is in position, it no doubt will be easy to communicate with Key West, Guantanamo and Bluefields. Electricity is supplied by the Commission's plant at Porto Bello, and the station "ground" is secured by means of 16 copper plates, each 3 x 6 ft., sunk in the bed of the Porto Bello reservoir.

Telephone Improvements in the Canal Zone.—All of the iron wires used in the telephone system of the Canal Zone, Isthmus of Panama, will be replaced by copper wires. New switchboard sections have been added at Cristobal and a number of new cables will be strung in Colon and Cristobal. Old magneto telephones will be replaced by common-battery instruments. It is proposed to consolidate the Empire exchange with that at Culebra, which will give a four-section switchboard at the latter place, where it is proposed to centralize the administration of the telephone service. The new telephone directory of the Canal Zone contains about 1300 names.

Electrical Inspection for Salt Lake City.—A movement is on foot to have regular electrical inspection established in Salt Lake City. The National Board of Fire Underwriters' engineers in their report on Salt Lake, issued in December, 1909, has called attention to the fact that the electric wiring conditions in that city are bad. The Board of Fire Underwriters of the Pacific, in view of this situation, have sent a competent electrical engineer to Salt Lake City for the purpose of making inspections. It is quite possible that the city will pass an ordinance adopting the National Electrical Code as the standard of electrical construction in the city. This, if backed up by the Underwriters' inspection, will materially improve conditions in the future.

Danger of Spring Floods.—Owing to the unusually large quantity of snow that has fallen in many parts of the country during the present winter, it is quite possible that the spring floods may be unusually high and perhaps disastrous. Managers of water-power plants may find it wise, perhaps, to begin now to make arrangements for protection in view of this possibility. Mr. Robert R. McCormick, president of the Sanitary District of Chicago, which has a large hydroelectric plant on the Chicago Drainage Canal at Lockport, Ill., reports that he has just returned from a tour of the country west and north of the North Shore channel and that he finds a greater quantity of snow on the ground than has been seen in years. When this snow melts and is supplemented by the spring rains, it is very likely that great floods will result. It is said that all streams are now practically bank full and will be out of bounds if swollen to a much greater extent. Preparations are being made along the Drainage Canal to take care of the flood water. The breaking up of the ice, too, is likely to add to the anticipated trouble, and the situation seems to be one that demands intelligent forethought.

Governor Deneen Campaigning for Waterway Legislation.—Gov. Deneen of Illinois is exhibiting great activity in furthering his favorite project, the construction of a deep waterway connecting the Chicago Drainage Canal at Lockport, Ill., with the Illinois River at Utica, Ill. The citizens of the State have voted favorably on a bond issue for $20,000,000 to provide funds for this enterprise, but the Legislature, apparently to the Governor's annoyance, has not yet sanctioned the enterprise. The State Senate has passed what is known as the Schmitt bill, authorizing the construction of the proposed waterway, but this measure is at the present writing apparently buried in the waterways committee of the House. The Governor is anxious to arouse public sentiment in favor of the bill, and he has been going around the State making speeches. He said in an address at East St. Louis on Feb. 3 that he is as positive that the deep waterway will be built as he is that he is alive. He intimated that if the present Legislature refused to perform its plain duty, there would be no hesitation on the part of the executive to continue to press the matter. The Governor declared that the water-power to be developed by the proposed waterway must be used for the benefit of the entire State, and not turned over to any private corporation. Mr. Deneen took occasion in his speech to mention the Economy Light & Power Company, of Joliet, saying particularly that the power to be developed should not be turned over to that company nor to any other private interest or collection of interests.

Hotel Telephoning.—It is stated that 501,375 telephone messages were sent from the Waldorf-Astoria Hotel in New York during the past year. At 10 cents per message, the income from this service was $50,137.50.

Gift for Rensselaer.—The Pittsburgh local alumni of the Rensselaer Polytechnic Institute have provided funds and designs for the erection of an administration building and library for the institute at Troy, N. Y., to cost $150,000.

Electric Service in Paris.—The restoration of the lighting, telephone and telegraph lines in Paris is proceeding slowly, following the fall of the Seine. The subway system is not yet in service, delay being caused by the necessity for cleansing and disinfecting the tubes after they have been emptied. It is estimated that the service will become normal within the next two weeks.

Meeting of I. E. S. New York Section.—The next meeting of the New York Section of the Illuminating Engineering Society will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, on Thursday, Feb. 17, at 8:15 p. m., and not on Feb. 10 as announced in last week's issue. A paper entitled "Schoolroom Lighting," by Messrs. George W. Knight and Albert J. Marshall, will be presented.

Rescue by Wireless.—The highly important service that can be rendered by wireless telegraphy was shown again when a sinking vessel at sea called to its aid a ship, 65 miles distant, on Feb. 4. The vessel in distress was the steamship *Kentucky*, having a crew of 47 men, who were rescued during a heavy sea in lifeboats sent from the *Alamo*. The former ship had proved unseaworthy, although inspected immediately before her departure from Newport News for St. Lucia, British West Indies.

French Engineers Criticised.—The French engineering profession is being attacked from all sides on the score that its members are to blame for the invasion of Paris by the floods. M. Frédéric Masson, of the French Academy, asks who are more nefarious, the Parliamentarians or the engineers, and substantially declares that the latter are. M. Charles Bos asserts point blank that Paris is the victim of the pseudo-science of the engineers. The dry rot of formal technology, he says, has done the harm.

Armour A. I. E. E. Branch.—At the February meeting of the Armour Branch of the American Institute of Electrical Engineers, held in Chapin Hall, Armour Institute, Chicago, on the evening of Feb. 3, Mr. G. E. Williams, a member of the junior class in the school of electrical engineering, read a paper on the subject of "Interior Wiring." His remarks were confined to wiring for residences and apartment buildings. The speaker exhibited several typical specifications and explained the appropriate uses of knob-and-tube, molding and conduit construction for interior work.

Magnetic Survey.—The work of making a magnetic survey of Africa, which has been conducted since November, 1908, has been practically completed. The region covered includes Rhodesia, Portuguese East Africa, German East Africa, Uganda and the British East African Protectorate. The work has been done by Dr. J. C. Beattie, director of the department of physics at the South African College at Cape Town, and Prof. J. T. Morrison, director of the department of physics in Victoria College, under the direction of Dr. L. A. Bauer, the head of the department of terrestrial magnetism of the Carnegie Institution.

Patents Issued During 1909.—During the year 64,408 applications for patents were received and 1234 applications for designs. Of these, 37,261 letters patent were issued. The report includes a comprehensive statement showing the number of patents issued by the United States and foreign countries from the earliest period to December, 1909, to have been 2,999,733. New York headed the list of States with 5232 patents during the year. The next one on the list was Pennsylvania with 3641, followed by Illinois with 3503. Nevada came last with 38. The number of electrical patents is not specified, but these aggregate about 3200, or about 60 per week.

Conservation of National Resources.—Another attempt is to be made to utilize the waste heat from coke ovens by generating steam for use in prime movers driving electric generators. A plant of this kind has been installed at the Shamrock plant of the Fayette Coke Company. It has been estimated that heat worth $32,000,000 has been escaping from the coke ovens of the Connellsville region each year, and arrangements have now been completed for capturing about half of it a year and turning it to good effect. The company expects to light the entire coke region with electricity, and also run the street car systems of that end of western Pennsylvania.

Electrotechnical Encyclopedia.—The publication has been commenced in France, under the auspices of a commission of engineers, of an electrotechnical encyclopedia. The chairman of the commission is M. Loppe, who served in a similar capacity some years ago in the publication of a work comprising many volumes of monographs relating to various departments of engineering in general. The encyclopedia will consist of 54 sections, each forming a pamphlet of from 80 to 100 pages or over. Sections on electrostatics, wattmeters, storage batteries and tests of electrical machinery have been issued, and the other sections will follow at stated intervals. The price of subscription is fixed at 115 francs, payable 10 francs when subscribing and 10 francs upon the delivery of each five sections.

An Englishman Criticises Electric Signs.—An English writer in a London journal gives the following as his impression from the sight of electric signs in New York City: "At night it is terrible. Atop of the topmost buildings the awful moving electric sky signs writhe and twist into the darkness. An electric sky sign that stands still is horrible enough; but when, at a great altitude, it performs astonishing acrobatics to proclaim the virtues of some flat-catching line of goods it is not only shocking, but disgusting. An advertisement for waterproof coats for ladies is a perpetual illuminated shower of electric rain, with an electric lady's skirt spasmodically spreading in electric wind. A brand of cocoa has a Gargantuan electric cup, with blue electric steam evermore winding Medusalike round its rim. I have seen New York men, doubtful of their state of mind, press their hands to their brows and stagger away from the sight muttering incoherencies. And these were seasoned saloon seekers by the looks of them."

Responsibility for Paris Flood Damages.—The question has been raised regarding the pecuniary responsibility of the public utility companies for flood damages. In the case of the Orleans & Western Railroads and the Metropolitan Subway, experts agree that the tunnels constructed below the level of the Seine, which were converted into raging torrents during the flood, were the direct cause of the inundation of cellars or houses which otherwise would have escaped. M. Barthelemy, professor of municipal law at the Sorbonne, and several other eminent lawyers say that individuals who have thus suffered are undoubtedly entitled to indemnification. The fact that the companies received municipal or Government concessions, they claim, in no wise relieves them of the risk involved in the execution of the concessions. It is probable, therefore, that thousands of claimants will enter suit against the companies. The Western Railroad is now the property of the State. Such suits will be decided by the Council of State, and the principle involved is likely to attract wide interest beyond the borders of France.

CASTELNUOVO-VALDARNO TRANSMISSION PLANT.

An Italian Generating Station Located at Lignite Mines and Transmitting Energy to Five Cities.

THE Mining & Electric Company, of Valdarno, possesses valuable deposits of lignite at San Giovanni-Valdarno, in the Province of Tuscany. In order to work these deposits economically it encountered great difficulties because the lignite contains 40 per cent to 50 per cent of water, which added to the already low heating power of the fuel. The company decided to erect an electric plant and a distribution system in order to utilize the combustible on the spot and distribute the energy in the form of electricity to the numerous centers of consumption in this region. The electricity is distributed in the form of three-phase current at 33,000 volts by means of five high-tension lines and is sent to Florence, Prato, Figline, Siena and toward the Valdarno region.

The power plant is built near the lignite deposits, and the lignite fields are connected with the boiler house by a railroad track. The fuel, after its extraction from the deposits, is left for some time exposed to the air in order to give it a superficial drying. It is then transported to the boilers and burned at once. The boilers are of a special type and the furnaces are adapted to burn the low-grade fuel economically. According to tests made, it was found advantageous to utilize the combustible having its natural amount of water in spite of the larger boiler plant required. An automatic system is used for the furnace feed. The lignite is stored by means of a bucket conveyor in bunkers above the boilers. The same conveyor serves also to transport the ashes out of the boiler-room, whose equipment comprises 10 boilers of the Babcock & Wilcox type. With a charge of 4.5 tons of lignite each boiler furnishes 13,000 lb. of steam per hour at a pressure of 200 lb.

The generator-room is built directly against the boiler-room, and in front of the dynamo-room is the space occupied by the transformers and other apparatus. There are at present installed in the generator-room three horizontal, triple-expansion, four-cylinder type steam engines (one cylinder each for the high and the intermediate pressure and two cylinders for the low pressure) constructed by the Italian firm of Franco Tosi. Each of these engines furnishes 2400 hp at the normal rate, with a speed of 94 r.p.m. They are provided with valves of the Lentz type and with ball governors. To the engines are direct-coupled three alternators of the three-phase type, constructed by the British Westinghouse Company.

The alternators are rated at 1500 kw, and the three-phase current is delivered at a tension of 6000 volts and at a frequency of 50 cycles. The field coils of the machines are energized from exciter busbars which are common to all the groups of alternators. These busbars are supplied by two shunt-wound generators rated at 130 kw each. One of these exciters is operated by a vertical two-cylinder engine, and the second machine is coupled to a non-synchronous 200-hp, three-phase motor supplied from a circuit at 220 volts and 50 cycles. The generator voltage is raised by transformers to 33,000 volts, which is the standard tension used on the overhead line.

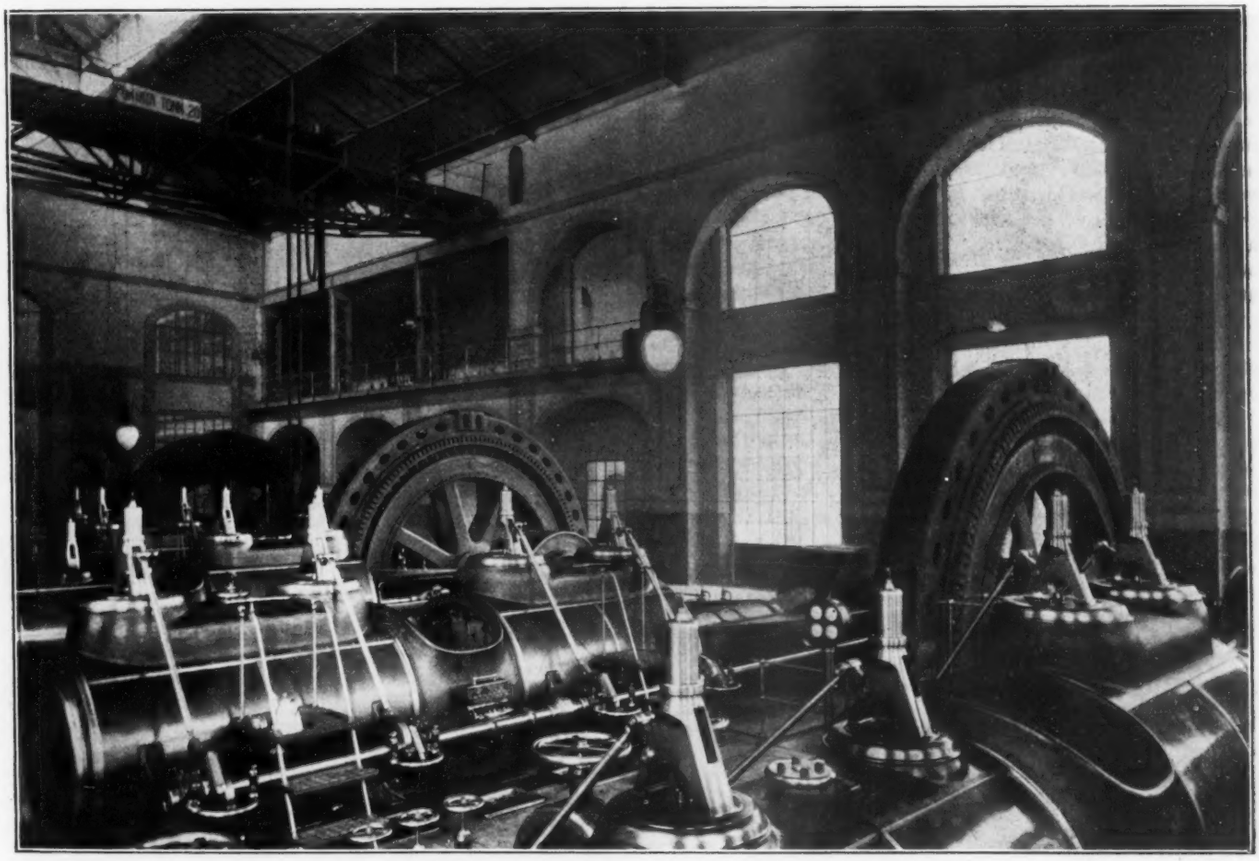


Fig. 1—Generator Room of the Castelnuovo-Valdarno Station.

The high-tension ends of the transformer groups are connected upon the main 33,000-volt busbars by an automatic oil circuit-breaker. The busbars are disposed so as to form a continuous loop, upon which are connected the auxiliary apparatus for the measuring instruments. The five transmission lines of the plant are connected to this system by means of an oil circuit-breaker. On the ground floor are installed the apparatus and lines of the exciter circuit and of the 6000-volt circuits of the transformers, and in this space are also mounted the transformers. On the second floor are mounted the high-tension switches of the transformer groups, the busbar loop

working at 33,000 volts and the principal operating platform with the operating apparatus for the alternators. In this space is also mounted a switchboard which is designed to contain the switches for the transformers as well as the line switches. On the upper floor are placed all the apparatus needed for the outgoing lines.

The alternators are connected by bare copper bars mounted upon insulators. A compartment of the switchboard is used for each of the alternators, and it contains upon the front part a measuring transformer for the voltmeter, two measuring transformers for the shunt coils of the relays for return current and for the double wattmeter, as well as the two lever-operated switches of the oil type for connecting the alternator upon its respective transformer group or else upon the auxiliary busbars. On the opposite side of the switchboard are mounted the oil circuit-breaker which is provided with an automatic release with a second relay, a service transformer for the ammeter, two for the relay and two for the double wattmeter. Opposite the compartments of the board and in a gallery are placed the main rheostat of the alternators and the shunt rheostats of the exciters, also the switches for these two circuits.

The control of the alternators and exciters is carried out from the main platform, which is placed in the second floor and just above the apparatus mentioned. The measuring instruments and the working levers for the alternators are mounted together upon an iron column which carries a main ammeter, an exciter ammeter, a double voltmeter, a double wattmeter and two signal lamps for showing the position of the automatic circuit-breaker. At the right of the column is a working lever for the latter and two levers for the two switches for parallel operation. As these latter are only operated at no-load, they have an interlocking device which connects them with the main switch. This device prevents the closing of the main switch before one of the other switches has been closed and prevents one of the latter from being opened before opening the main switch.

The double-pole switch, with carbon contacts, used for the exciting circuit, is operated from the column by means of an endless-screw mechanism. The main rheostats for regulating the field of the alternators are provided with two sets of contacts and two hand-wheels. But one hand-wheel can be worked at a time, however, and the second one only when the first wheel has finished its course. The exciter-circuit switch and

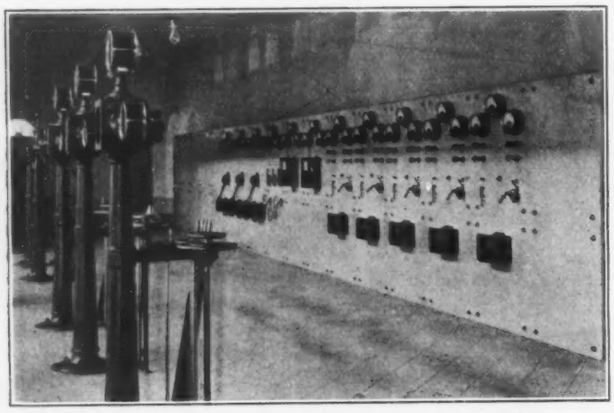


Fig. 2—Switchboard Gallery.

the main oil switch of the alternators are connected together by an interlocking system to prevent the closing of the alternator switch before the exciter circuit is closed, and vice versa.

The compartments which contain the transformer groups are placed immediately back of the apparatus panels of the respective alternators. Three 600-kva, single-phase transformers are connected in delta, and the three-phase group which is thus formed is placed in one of the compartments. These transformers are of the usual type with superposed coil, using an air-blast ventilation. The primary winding is separated from the high-tension coils by a cylinder formed of treated paper and mica layers. The cylinder extends farther than the coils at the top and bottom so as to avoid all danger of a discharge between the two circuits, even for a voltage 1½ times normal. The high-tension winding is divided into 26 partial coils for each core, so that between the two ends of each sectional coil

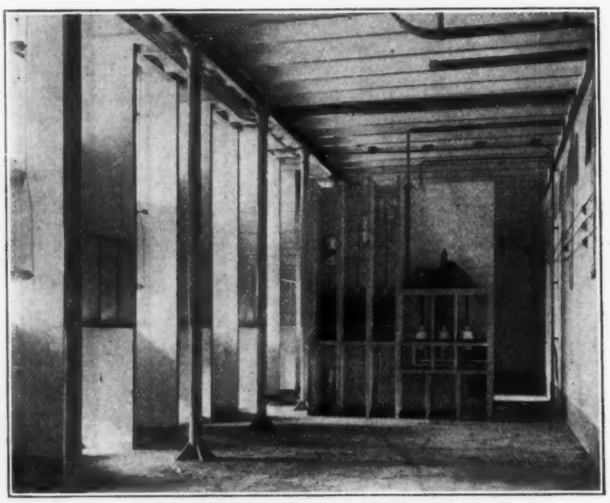


Fig. 3—High-Tension Transformer Switch and Bus Connections.

there is a difference of potential of from 600 volts to 800 volts at a maximum. As they are mounted upon rollers, the transformers can easily be transported to the repair shop if necessary by means of a small truck. The switches which connect the terminals of the transformers of the same group are mounted on the inside of the compartments. Cement partitions, 6 ft. high, are used to separate the different transformers of the same compartment.

Under the transformers are placed the conduits for the air draught. For each group a Sulzer air fan is used, driven by a separate motor. The motors for the fans are controlled from a switchboard which is mounted on the central platform; an acoustic signal serves to show whether any one of the fans is working or not.

At present there are installed in the plant three groups of transformers, but the transformer building and the switchboard are laid out for seven groups. In one compartment are placed four transformers of 250 kva which serve to lower the tension from 6000 volts to 130 volts or to 220 volts. Energy from these is used for the inside circuits of the premises, such as the lighting of the station buildings, and for the various motors. Three of the transformers are connected in delta and form a three-phase group, of which the secondary ends are connected in star. The fourth transformer serves as a stand-by, and it is readily put in service by means of section-blades which make connection with any one of the three sides. For the primary and also for the secondary circuits of these transformers the connections are made by section switches in the same way as for the main transformers. The apparatus used with these groups is mounted in special compartments placed on the ground floor.

From each of the compartments of the main transformers six conductors corresponding to one group lead up to the second floor, and the connections in delta are made at this point. The conductors are taken thence to the main 30,000-volt busbars of the plant.

The circuit-breakers on the outgoing lines are of the automatic type with slow-acting relays and are provided with an electromagnetic device for operating them from the board which is placed upon the main platform. A bar for giving a ground connection is provided, by means of which each line

can be grounded. This is done on account of the fact that in the line network of the Tuscany region there are several substations for lighting purposes which are connected to a network by synchronous motors. These motors are direct-coupled to generators and work in parallel upon storage batteries. The generators might act as motors fed from the storage battery and thus the group would feed into the high-tension mains. This could take place after the opening of the switches of the main line, and the latter would thus carry the full voltage. In order to avoid any danger from this source it was desired to ground the different line wires as above indicated.

The lines are well protected against atmospheric discharges or over-voltage. Each pole is equipped with a horn lightning arrester which is placed in series with several liquid resistances. An earth-discharger, with water circulation, connects the line constantly to ground and thus allows the static charges to be taken off. The lightning arresters are mounted in cells, so arranged that there is a free space above them for blowing out the arc. The liquid resistances are contained in earthenware tubes, and four resistances are used per pole.

According to the method used for checking the insulation of the pole lines it is easy to test each of the lines separately and also each pole of a given line. To this end there are used three special busbars, which are brought to the switchboard by high-tension cables, having in circuit an automatic oil circuit-breaker, as well as a choke coil.

Each line is provided with a three-way switch which is operated from the switchboard by an electromagnetic device, and this allows of connecting each line with the special busbars. Each of the choke coils can be grounded, placing in the circuit an ohmmeter and a battery of 78 Siemens dry cells. In this way the insulation resistance of each pole of the line is measured. A special panel for this purpose carries three ohmmeters and various other instruments and connections. Each panel of the outgoing lines has three ammeters, a switch for operating the automatic circuit-breaker, as well as the signal lamps and other instruments.

At present there are in operation five main pole lines of 33,000 volts leading from the Castelnuovo plant. A line 16 miles long serves to supply the substation at Florence. A second line, 33 miles long, runs to the substation at Prato, to the north of Florence. At the bifurcation point of these two lines there is a section switch house which allows of connecting the two lines in parallel. A third line leads to the town of Siena, 17 miles distant, and a fourth line reaches the iron works of San Giovanni, four miles away, while the remaining line runs

Fig. 4—Exterior of Station and Outgoing Lines.

to Figline, six miles distant. This latter line is to be extended in order to supply Valdarno.

The lines are mounted in general upon lattice-work poles, with insulators mounted upon wooden cross-arms. The minimum distance between the wires is fixed at 30 in. At the above-mentioned localities there are installed pole transformers for supplying local lines, and these latter are operated at tensions varying from 5000 volts to 260 volts.

SOME ENGINEERING FEATURES OF THE HAKONE, JAPAN, HYDROELECTRIC PLANT.

By S. Motomura.

ACTIVITY in hydroelectric development in Japan has been steadily recovering from the slump so generally experienced after the late war, and particularly the financial crisis of 1907. The plant of the Tokyo Gas & Electric Company on the Katsura-Kawa has since been completed, and is now in active service. The completion of the Hakone plant, however, opens a new page in the annals of the high-tension installations in the empire. The plant does not compare with that of the Katsura-Kawa in size, but it has features of highly significant character. The installation involved the trial introduction of modern steel towers and the notable use of apparatus and materials of domestic manufacture.

The plant is situated in the Hakone group of the mountain range which branches off directly southward from the famous Fuji-yama. The water intake is located at Miyanoshita, whence the water is carried to the reservoir at Tonosawa, over a route 15,000 ft. in length, of which 9700 ft. is made up of a series of tunnels. From this reservoir two parallel pipe lines, of 1800 ft. each, lead directly to two turbo-generator units in the power house proper. The carrying capacity of each pipe line is 40 cu. ft. per second, under a hydraulic head of 720 ft., the highest utilized in the country. Riveted pipes are used for the upper half of both pipe lines, while welded pipes are employed for the lower half. The former were manufactured by the Shibaura Electric & Mfg. Co., of Tokyo. The welded pipes are of German manufacture. The diameters of the pipes are 28 in. and 30 in., respectively, two sizes having been selected to facilitate transportation, the smaller nesting inside the larger.

At present the generating equipment consists of two 2000-kva General Electric revolving-field type alternators, each direct-connected to 2540-hp Voith high-pressure impulse water-wheels operating at 375 r.p.m. Each of the wheels is fed through a separate pipe line, while a third is now planned with the view of meeting further increase in the number of generating units. Duplicate three-phase circuits transmit the electrical energy generated a distance of 36 miles to the city of Yokohama. The generator pressure is 3450 volts, which is stepped up to the line potential of 46,000 volts by six General Electric 776-kva, water-cooled transformers, forming two banks of three each, a seventh being retained as a reserve. The line voltage, however, can be varied over a range of 46,000 volts, 45,000 volts and 44,000 volts by means of transformer taps.

The arrangement of the exciters may occasion some difference of opinion. There are two similar units, both directly connected to induction motors, which are driven by the main alternators. As one unit is sufficient to supply energy to the two generator field circuits, the other is kept as a reserve. In starting, the exciter is belted to the generator shaft and as soon as the normal voltage is obtained at the main busbars, power is supplied to the driving motor, and at the same time the belt-drive is removed by means of a loose polley. When the other exciter set is to be put into service the second exciter is first operated as a direct-current motor by the exciter already working. When the normal speed has been attained the alternating-current supply from the main bus is impressed on the induction motor of the set. Thus the two exciters are operated in parallel before the first is relieved from service. The reason given for not driving the exciters by water-wheels is the danger of complicating the high-head operation, as well as the lower first cost of the system now in use.

In the present transmission system both wooden poles and steel towers are used, although it is the intention that the latter shall replace the former ultimately. The system has afforded an excellent opportunity for studying the comparative merits of poles and towers. As the present installation had no precedent in the country in the use of the steel towers only 10 miles out of the total of 36 was built with the tower construction. The 166 towers thus far erected are used only where the poles would be objectionable from the scenic point of view, and

where the Government regulation requires an extra height of lines.

The design of the towers is of two general types, single or double insulators being employed. The latter type is used where the transmission lines curve or the span is exceptionally long. Both types carry seven lines, two three-phase circuits and a ground cable; while each of the pole lines consists of a single three-phase circuit.

The comparative study of tower and pole construction made by Mr. Samukawa, who designed the plant, may be of some interest as far as the two types apply to Japanese practice. The basis upon which he made his comparison is as follows: First, the ground cost necessary to erect poles and towers, one unit area (equal to 36 sq. ft. approximately) being allotted to each wooden pole or anchor, and four units for a tower. Second, the average span, which for the tower is 330 ft., and for the poles 134 ft., with the result for a two-circuit transmission, that five poles are equivalent to one tower in span. Third, the width of the right-of-way to be cleared of trees and brush, as required by the Government, 6 ft. on each side of the lines, making a total of 36 ft. for the parallel pole lines and 30 ft. for the single tower line. Fourth, the convenience and consequent reduction in cost of transportation of sectionalized towers against that of poles. Fifth, the smaller cost of erection of a single tower against that of the equivalent five poles. In so far as the cost of installation is concerned, the above consideration suffices to show the advantage of the towers over the poles. Electrically, the tower system results also in economy by reduction of insulator leakage by 60 per cent upon the basis of one double-circuit tower replacing five single-circuit poles. Assuming the leakage loss per insulator at 46,000 volts to be about 15 watts, the loss per tower is 90 watts, whereas the equivalent length of pole lines will have a total loss of 225 watts. The question of the comparative lives of the tower and pole is yet unsettled, owing to the very recent introduction of the tower construction, even in the United States. Mr. Samukawa, however, believes in the ultimate economy of steel towers properly designed. His design provides for an easy renewal of the lower portion of the four legs, which is especially subject to corrosion, by making special joints about a foot above the ground. On the other hand, certain disadvantages are inevitable with the present tower line—such as the necessity (though not absolute) of shutting off the entire system when repairing one of the circuits, the requirement of some special device for supporting the guard wire and protective net, the comparative difficulty in locating insulator troubles, and the possible increase of inductive disturbances to the parallel circuits of telephone wires, owing to the greater number of high-tension lines carried over a single tower.

The comparison of the pole and tower systems with reference to their first cost, when reduced to the actual values, shows that the pole line per mean tower line span is about 74 yen ($37) cheaper, costing 285 yen as against 359 yen for the tower system. These values cover the costs of materials, transportation, erection, and right-of-way, but do not include the copper wire. Mr. Samukawa argues, however, that this difference is largely due to the abnormal condition of the market at the time of placing his orders for steel towers. Basing his calculations upon the present market prices, the cost of a tower will become 20 per cent lower, and since a single tower cost at that time 272 yen on an average, the reduction amounts approximately to 54 yen. Thus the cost of tower system per span becomes 305 yen, which is only 25 yen higher than the equivalent pole line. Even at this, the poles used were chosen of an inferior quality, in view of the fact that all would have to be subsequently replaced by the steel towers.

The insulators used number over 7600. Of these about 1500 are Shibaura special high-tension insulators, the remainder being of the Thomas 12-in. type. Both are of similar dimensions, but against 23.8 lb. of a Thomas insulator, the Shibaura types weighs only 14.8 lb., and other advantages are claimed. No. 4 copper wire is used on the wooden poles, and No. 3 copper on the towers; while seven-strand No. 8 steel-wire cables are employed on the spans over two principal rivers which the system crosses. For the ground wires two-strand No. 8 iron cable is used on the pole lines, and seven-strand No. 13 cable is used on the tower portion. The transposition of the transmission lines amounts to a complete turn in every six miles for one circuit and in every 18 miles for the other.

The transformer substation at Yokohama is yet incomplete, with only four transformers installed. They are all of the Shibaura 600-kva, air-cooled, oil-immersed type. The high-tension side, connected in delta, has three special taps, giving 25,400, 24,830 and 24,250 volts per phase coil, respectively. The designer has thus allowed for 4.35 per cent line drop, giving 44,000 volts at the substation end of the system. There the e.m.f. is reduced to 3450 and 2300 volts for city distribution.

A LARGE INDUSTRIAL PLANT SWITCHBOARD—II.

Description of Controlling Devices of Distributing Circuits in an Oil Refinery.

By Warren H. Miller, *Electrical Engineer, Standard Oil Company.*

To the left of the main generator panels are three station panels, the first being for the exciters. The exciters consist of one Westinghouse 62.5-kw, 110-volt compound-wound generator driven with a directly connected Harrisburg steam engine, and one 65-kw motor-generator exciter. With high heat-unit gases a very favorable factor in aiding good steady parallel operation of the alternators is a steam-driven exciter, giving a fixed, steady field excitation which will not vary at all with any disturbances among the engines of the main generators. When a motor-generator is used its speed fluctuates with the load changes and adds to the variables just when it should be steadiest. Moreover, the motor-generator is a heavy charge on the output, whereas the exhaust steam from the exciter engine can always be usefully employed, thus making the work of the steam the only charge. The two exciters are connected in parallel to the exciter buses, not only for transfer, but because sometimes both are needed to carry the load. Both are provided with breakers at the top of the panel so that in case of a short-circuit it can be properly protected. The equalizer switch on the panel was made single-pole so as to give absolute independence between the machines when one is being used for exciting the generators and the other is charging the batteries of the works' electric locomotives, which it does for nine hours each night. Such independence could not be secured by using the third leg of a three-pole switch for the equalizer, as is usual.

The second station panel contains, among other devices, a single-phase, 480-volt, 25-cycle frequency meter, which is the handiest instrument on the whole board as it shows at a glance just what the revolutions of the engines are, points out instantly any change of load, gas, or steam pressure, and, what is more important, tells at once just how much the change in speed is, due to some large load going on outside. The sudden changes in the keynote of the power house are rather disconcerting unless some means is at hand to tell just how much the change is, and this the frequency meter shows at once, warning or reassuring the operators the instant the speed changes. It also serves as a guide in adjusting governors on putting a new engine in service, though this work could also be done with the aid of a good tachometer. This meter is plugged in circuit simultaneously with the incoming voltmeter.

A ground-detector on the board is connected at noon each day with all buses carrying energy, and, if a "ground" is reported, all the more lightly loaded feeder switches are snapped out and back again without affecting the motors, and the "ground" is either located forthwith or else determined to be on one of the large permanently loaded feeders, whereupon special arrangements can be made to test these circuits, one at a time, motor by motor. The static type of ground detector cannot be used in any industrial plant, not even as large as this one with its 15 miles of large feeders, because there is not

enough capacity to make its readings reliable. The industrial world still awaits the genius who will put out a detector which will always be on the circuit and yet will not permanently ground one side of it and thereby reduce the insulation by one-half.

No Tirrill regulator has been installed because the writer traded its value for other equipment much more needed, and

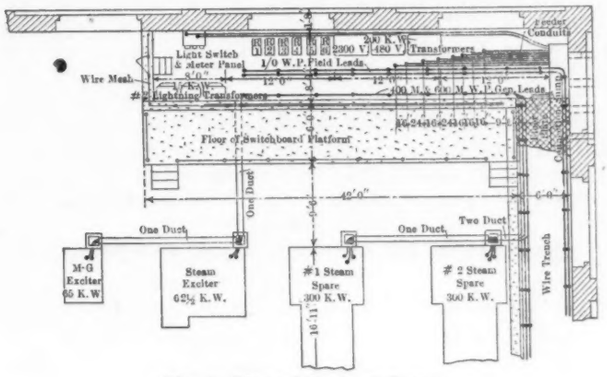


Fig. 1—Plan of Back of Board.

hence the shift engineers are still required to readjust the voltage by the field rheostat handles, whereas the regulator would have performed the duty at far less ultimate expense. Such a regulator costs about $250 and it should be used wherever the appropriation permits the expenditure.

The third and last panel is for the purpose of handling and metering the purely station auxiliary apparatus. Being the end panel on the board it also carries the swinging brackets with the synchroscope and bus and voltmeter for the incoming gen-

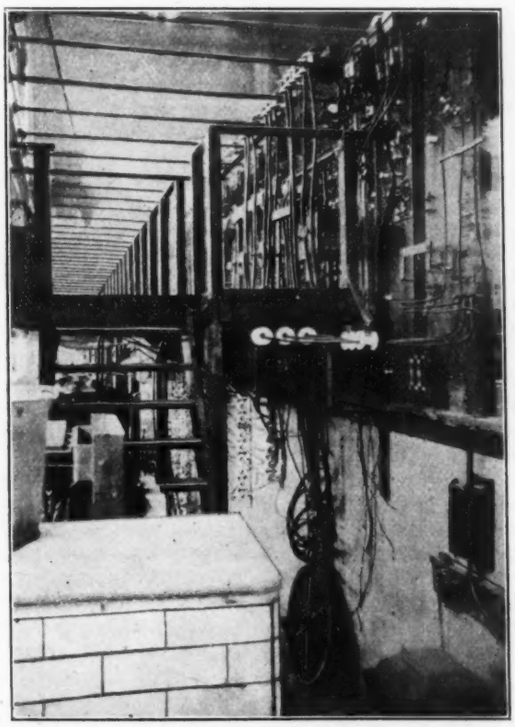


Fig. 2—View of Back of Board.

erator. On the panel itself are the voltmeter and ammeters for locomotive charging, double-throw switch for same, and switches, voltmeters and ammeters for gas-engine igniters and power-house auxiliary motor circuit.

For future increase the platform has 12 ft. of area, and to do it with the least disturbance back of the board a blank panel is put in at the extreme right of the generator panels. This is not for a future gas engine, but it takes the place of two more feeder panels covering the buses where these will come. To put on another gas engine, this panel will be moved down to the extreme left of the generator panels, the station panels being moved to make room for it. Then the second reserve steam unit will be moved onto it and its panel will be taken by the new gas engine. For this purpose the reserve steam panels were

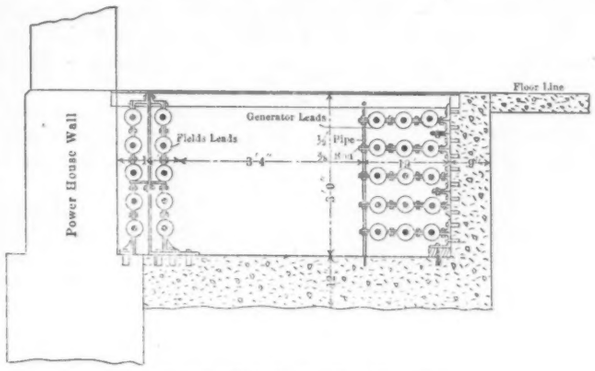


Fig. 3—Detail of Wire Trench.

made similar to the gas-engine panels except for the instruments which can easily be moved. Space is also left for another high-tension panel at the extreme right of the board, as future large departments will be very probably placed about 1.5 miles from the power house.

The general arrangement back of the board is shown in the sketch and photograph. Passing along the wall of the power house, across the fronts of all the gas-engine generators, is the main wire trench, 5 ft. wide and 3 ft. deep, covered with iron floor plates. The main wires are 600,000-circ. mil, triple-braided weatherproof stranded cables run in three-wire, cast-iron cable brackets with split porcelain spools. They are bolted to flat iron forgings and arranged as in the illustration. The main leads take the inner side of the trench, and the field circuit leads the outer, leaving a space about 30 in. for a man to get at either set of wires.

The switchboard is set on a 12-in. concrete wall rising 3.5 ft. above the floor and 8 ft. from the end wall of the power house. The wire trench ends at this wall, and all the space back of it is excavated to the bottom of the wire trench and floored with concrete. This arrangement gives a total height to the wall at the back of the board of about 8 ft., and on it are arranged the main feeders in cable leads, spaced 4.5 ft., and carrying the 15 main cables spread over the face of the wall, all easy to get at and taking only 5 in. of the room back of the board. In the rest of the space are arranged the three main 200-kw, single-phase transformers, the generator field-circuit resistors, the nine 2-in. galvaduct outgoing feeder conduits, the No. 2 lighting transformer station of three 15-kw transformers with their switch and meter panel, the cable brackets for the generator field-circuit leads, and the yellow-pine gallery platform behind the main switchboard panels.

In order to get the nine sets of feeder wires out of the power house and yet not run overhead and interfere with the crane hook when lifting out transformer cores, etc., use was made of the galvaduct conduit pipes mentioned. As the feeder wires were of No. 4-0 stranded cable, the bends of these pipes would have to be very "easy" so as to pull nicely and the radius was, therefore, put at 3 ft. Before pouring the concrete for the floor all of these feeder pipes were set up and the bends secured vertically with shores. When the concrete had set all were rigid and fast and each was topped with a 2-in. cast-iron three-wire entrance cap at 8 ft. above the floor. All of the pipes led side by side into a connection sump 96 in. x 24 in. x 8 in. deep, alongside the power-house wall. Into this sump extend also the 2-in. conduit pipes leading out of the power house and up the two main terminal poles. To connect the switchboard to the outside lines three No. 4-0 stranded

double-braid, red-core, rubber-covered cables were pulled in the conduit pipes down the poles and connected at the sump with the corresponding cables in the 2-in. conduit bends back of the board. These then jump directly from the entrance cap to the switch terminals of the feeder panels.

The high-tension wires were run on 3000-volt glass inverted insulators placed under the wooden gallery back of the board, where they are entirely out of the way of the crane hook. The leads from the 2300-volt oil switch to the outer wires run up the power-house wall behind the crane girder and cross to their own pole circuit, being at no time on any pole with a 480-volt circuit.

Underneath the gallery were hung also the generator-rheostat button plates, and to it were also bolted the supports which carry the shaft and sprockets of the rheostat handles on the generator panels.

The handsome platform in front of the board was very cheaply constructed by laying up a single brick wall of the same white enamel-face brick which forms an oil guard clear around the power house. Across from this to the switchboard are laid 6-in. I-beams which carry a 4-in. reinforced-concrete floor. An iron guard rail is let into this floor and a rubber mat keeps the platform from getting grease soaked and also insulates the attendants while handling switches and cleaning the board. In the space under the platform, which is entered by a small oak door at each end, are kept all the spare parts of the steam engines, gas engines, exciter engine and four air compressors.

It is well to realize that the switchboard of an industrial plant not only controls and distributes both the load and the electric output, but is also the cash register of the power house, so to speak. For the business of the power house is to sell electric energy and compressed air, which must be measured, weighed and billed each month to the various departments, just as they charge it for everything they furnish. The monthly main generator readings should check within 2 per cent of the feeder totals or some one of them is wrong—due to meter fuse being out, current or voltage leads crossed or some such matter. The meter transformers are accurate within 1.5 per cent, and the instruments within 0.5 per cent, and hence any difference greater than 2 per cent should be investigated at once. If no meters are on the feeder panels in the power house and only the sum totals of isolated shop meters are taken, then the entire line loss falls on the power house.

With the board described above many large departments are charged directly from the feeder-panel meters. Others, comprising several independent shops, have separate meters at the shops and the line loss is ascertained by subtraction from the main feeder meter on the panel. With the lighting feeders both the line and transformer loss are ascertained by subtraction of the sum of the 110-volt lighting-feeder meter-readings from reading of the three-phase meter on the panel. It amounts to a good deal, particularly where the department uses a few lamps throughout the day and thus incurs a large light-load transformer loss. Long-distance charges are made up by putting on a meter at the point of distribution and subtracting its reading from the total readings on the feeder panel, the balance being the energy used by motors. All locomotive charging expenses are read directly from the power house and station circuit meters. A credit of 50 per cent of all the steam used is allowed when the condensation of steam reserves exciter engine and steam air compressors is returned to the boiler-house hot-well.

The switchboard is the executive and supervisory, as well as the business department, of the power house. It keeps steadily in sight the r.p.m. power-factor, state of electric ground, voltage, present output of each engine running, and just what departments are using energy. The latter fact can be ascertained by a glance at the feeder watt-hour meter wheels and is extremely useful information when some sudden and mysterious change takes place in the general speed of the prime movers.

When a feeder line is struck by lightning the switchboard takes care of the disturbance, and when the feeder is using too much current or has become grounded the feeder ammeter and the ground detector indicate the trouble. Similarly, when two motors are used in some department to do the work of one the power-factor meter indicates the condition by dropping from 90 per cent to somewhere about 65 per cent. The general power-factor of the work runs from 87 per cent to 95 per cent, and is kept at this high figure simply because the power-factor of each department is reported daily on the log and any lapse is immediately investigated and remedied.

The cost of the board described above was about $7,200 completely erected, and the foundations, connections and accessories to it cost about $1,000 more. The cost was not a very heavy item in a total of over $225,000 for electric equipment. It is the writer's belief, after designing and installing many boards as accessories for industrial-plant power houses, that if there is any one thing on which it pays to spend money to obtain the best, it is the switchboard which manages all the output of the power house.

ECONOMICS OF SYNCHRONOUS CONDENSERS.

The Monetary Value of the Overexcited Synchronous Motor in Power Transmission.

By B. F. Jakobsen.

An overexcited synchronous motor will draw a leading current from the system to which it is connected and thus can be used to supply magnetizing current for inductive loads and thereby improve the power-factor of the system. It may be desired to raise the power-factor for various reasons, such as to improve the inherent regulation of the system, as it is well known that a system with a low power-factor is much more sensitive to load changes than one with a high power-factor; or to utilize the full output ability of the prime movers in a station where with a low power-factor the generators and transformers are overloaded and the prime movers only partly loaded; or to decrease the losses in the transmission and distribution circuits and at the same time improve the efficiency of the generating equipment. In the last two instances the question is purely economic, whereas the first named is more or less subject to personal opinion; improved regulation is, however, incidental to any increase in the power-factor of a system.

Wherever a synchronous motor drives a direct-current generator the motor can be made to work at unity power-factor at all loads by causing the generator current to pass through the field coils of the motor, and in that way varying the field with the load. However, where a synchronous motor is used to drive a mechanical device this result cannot be so readily accomplished. Moreover, in order to regulate the leading kva load of a synchronous motor with varying load and power-factor on the generators so as to secure the desired effect upon the power-factor of the system, it is desirable to place the motor in a substation where the operator may give it attention at all times.

The cost of a synchronous motor equipment connected to the system may be decreased in different ways: Either by installing a motor of larger rating than needed and running it overexcited or by installing synchronous motors for ordinary industrial service and running them idle at their full kva rating during the peak-load period. By using some form of "limited service" this result could most readily be accomplished. The tendency of synchronous motors to fall out of step, due to voltage surges on the transmission system, is, of course, a decided drawback. Moreover, care should be exercised in obtaining motors of very nearly the same wave shape as the alternators, as otherwise there will be large exchange currents in addition to an unpleasant readiness to trip the circuit-breaker on the slightest provocation.

CASE I.—INCREASED OUTPUT.

Assume a hydroelectric station equipped with prime movers large enough to drive the generators at unity power-factor and full-load rating. The output of the station is to be increased by raising the power-factor of the load, keeping the kva load on the generators constant, by adding a leading kva load due to

overexcited synchronous motors connected to the system. It is assumed to facilitate calculations that the higher efficiency of the generating equipment with improved power-factor will balance the windage, friction and copper losses of the idle synchronous motors.

Let g = the constant maximum kva rating of the generating equipment,
m = the lagging kva load on the generators,
s = the leading kva load due to overexcited synchronous motors,
w = the load in kilowatts,

then

$$g^2 = w^2 + (m-s)^2$$

In order to determine the leading kva load necessary to increase the power-factor at different power-factors there is obtained from Fig. 1:

$$g \cos\theta = w;\ g \sin\theta = m - s \ldots\ldots\ldots\ldots (1)$$

The gain in power for a certain variation of cos θ is then:

$$\Delta w = w_2 - w_1 = g(\cos\theta_2 - \cos\theta_1) \ldots\ldots\ldots (2)$$

The synchronous motor rating needed to decrease θ from θ_1 to θ_2 is:

$$s = m - g\sin\theta$$
$$\Delta s = s_2 - s_1 = g(\sin\theta_1 - \sin\theta_2) \ldots\ldots\ldots\ldots (3)$$

Let K = price per kilowatt per year, and
S = cost per year of each installed kva of synchronous motor rating, including interest, depreciation, maintenance and the desired profit upon the investment,

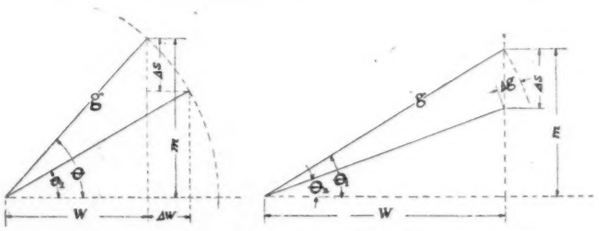
then a load Δw will realize such a profit, or a larger one, if

$$K \times \Delta w \geqq S \times \Delta s \ldots\ldots\ldots\ldots\ldots (4)$$

or substituting from (2) and (3) and aranging,

$$\frac{S}{K} \leqq \frac{\cos\theta_2 - \cos\theta_1}{\sin\theta_1 - \sin\theta_2} \ldots\ldots\ldots\ldots (5)$$

If there be any charge for water or any charge whatever depending directly upon the load, then that charge must be



Figs. 1 and 2—Voltage Vectors of Synchronous Condenser.

deducted from the price obtained per kilowatt in order to get the value of K. The losses in the transmission line are not changed because the kva load is constant. In case of a charge for water the efficiency of the water-wheels would also enter into this consideration.

Equation (5) will not indicate the economical power-factor for the reason that part of a certain load Δw may be furnished at a loss and still the entire load may represent a profit. In order to determine the economical power-factor, from equation (1) there is obtained,

$$ds = (g \sin d\theta)\cos\theta;\ dw = (g\sin\theta)\sin\theta \ldots\ldots (6)$$

and by division:

$$\tan\theta = \frac{dw}{ds} \ldots\ldots\ldots\ldots (7)$$

where dw is the gain in kilowatts corresponding to a leading kva load ds at a power-factor of cos θ. Substituting in (7) the price per kilowatt of power and kva of motor rating, there is obtained:

$$\tan\theta = \frac{S}{K} \ldots\ldots\ldots\ldots (8)$$

This equation expresses the economical value above which it would not pay to increase the power-factor by adding idle synchronous motors, for at this power-factor the income due to additional load derived from improving the power-factor exactly balances the cost plus profit of improving the power-factor. Above this power-factor the profit derived is less than the desired.

From equations (2), (3), (4) or (5), one can determine how big a profit a certain load would represent, and from (8) whether any part of this load represents a profit less than the desired.

CASE II.—DECREASED LOSSES.

Assume full load on the prime movers of a hydroelectric station and power to be obtained by raising the power-factor and thus reducing the copper losses of the transmission line.

Let w = constant load on prime movers in kilowatts,
e = line to ground voltage at station in kilovolts,
m = kva lagging load on station,
s = kva leading load added, due to idle synchronous motors,
cos θ = power-factor at station,
r = resistance of one wire per mile in kilo-ohms,
x = inductance e.m.f. for one wire per mile per ampere, in kilovolts,
l = length of line in miles.

The entire load on the station is made up of the kilowatts and kva lagging load due to motors, lamps, etc., connected to the system, in addition to the kw-load represented by the copper losses in the line, and the kva lagging or leading load represented by the self-induction and the capacity of the line. It is assumed that the increased efficiency of the generators and transformers offset the losses due to the idle synchronous motors. The loss in the line, in kilowatts, is:

$$L = \frac{w^2 rl}{e^2\cos^2\theta} \ldots\ldots\ldots\ldots (9)$$

This loss will be decreased by decreasing the phase angle so that:

$$\Delta L = L_1 - L_2 = \frac{w^2 rl}{e^2}\left(\frac{1}{\cos^2\theta_1} - \frac{1}{\cos^2\theta_2}\right) \ldots\ldots\ldots (10)$$

ΔL represents, therefore, the additional power available with a decrease of θ from θ_1 to θ_2. In order to determine the kva rating of synchronous motors necessary to effect this increase of power-factor, there is obtained from Fig. 2:

$$w\tan\theta = m - s;$$

but here m is not a constant as it includes the lagging kva load due to line reactance and this varies with the power-factor as the power is constant. The kva due to line capacity does not vary with the load to any extent and may so be considered constant. If m' is the constant kva load due to motors, lamps, etc., then

$$m = m' + \frac{w^2 lx}{e^2\cos^2\theta}$$

and

$$w\tan\theta = m' + \frac{w^2 lx}{e^2\cos^2\theta} - S$$

and

$$S = m' + \frac{w^2 lx}{e^2\cos^2\theta} = wtg\,\theta \ldots\ldots\ldots\ldots (11)$$

and

$$\Delta s = s_2 - s_1 = w(\tan\theta - \tan\theta_2) - \frac{w^2 lx}{e^2}\left(\frac{1}{\cos^2\theta} - \frac{1}{\cos^2\theta}\right) \ldots (12)$$

The cost plus desired profit of furnishing Δs is $S\Delta s$; the average cost per kilowatt for a load increase ΔL, therefore,

$$k = S\frac{\Delta S}{\Delta L} \ldots\ldots\ldots\ldots (13)$$

Equations (10) and (12) will supply Δs for any ΔL and initial power-factor cos θ, or vice versa, and from (13) the average cost per kilowatt may be determined. These equations do not, however, furnish a criterion as to how large a load increase would be economical; in order to ascertain the economical power-factor equation (9) may be differentiated:

$$dL = \frac{2w^2 rl}{e^2\cos^3\theta}\sin\theta\, d\theta \ldots\ldots\ldots\ldots (14)$$

from (11)

$$ds = 2\frac{w^2 lx}{e^2\cos^3\theta}\sin\theta\, d\theta - \frac{w}{\cos^2\theta}d\theta$$

The minus sign implies that ds and $d\theta$ vary inversely; neglecting it, there is obtained:

$$ds = \frac{w}{\cos^2\theta}\,d\theta - 2\,\frac{w^2lx}{e^2\cos^3\theta}\sin\theta\,d\theta \qquad (15)$$

and combining (14) and (15):

$$\frac{dL}{ds} = \frac{2w^2rl\sin\theta\,d\theta}{e^2\cos^3\theta\left(\frac{w\,d\theta}{\cos^2\theta} - 2\,\frac{w^2lx}{e^2\cos^3\theta}\sin\theta\,d\theta\right)} = \frac{2\,wrl\sin\theta}{e^2\cos\theta - 2\,wlx\sin\theta}$$

From (4),

$$\frac{dL}{ds} = \frac{S}{K}$$

so that

$$\frac{K}{S} = \frac{e^2}{2\,wrl\tan\theta} - \frac{r}{x} \qquad (16)$$

and,

$$\frac{Kr + Sx}{sr} = \frac{e^2}{2\,wrl\tan\theta}$$

and

$$\tan\theta = \frac{e^2}{2\,wrl}\,\frac{S}{Kr + Sx} \qquad (17)$$

$$\tan\theta = \frac{26^2}{2\times 1500\times 66} = \frac{4\times 10^3}{65.7\times 0.671 + 4\times 2.95}$$

$$\tan\theta = 0.303;\quad \cos\theta = 0.957.$$

Suppose that the initial power-factor was $\cos\theta_1 = 0.8$, and that this is raised to $\cos\theta_2 = 0.957$, that the annual interest, depreciation and maintenance charge S is \$3, and that $K =$ \$65.70, then from (10) for the two three-phase circuits:

$$\Delta L = 416.2 \text{ kw, or } \$27{,}230,$$

and from (12)

$$\Delta s = 2810 - 183 = 2627 \text{ kva, or } \$7{,}881;$$

the difference is \$19,349, and figuring an outlay of \$20 per kva rating of synchronous motors, or \$52,540 for the entire equipment, there remains a profit of 36.9 per cent upon the investment.

Here cos θ represents the economical power-factor under the given conditions—that is, any power secured at prevailing prices by increasing the power-factor above this value would not earn the desired profit upon the investment. By not including any profit in the value of S, but merely the interest, depreciation and maintenance charges the value of cos θ at which expense and cost are equal would be found; naturally that value is of little importance.

A combination of the two conditions assumed above, for example, a power plant at the end of a transmission line with full load on the generators and only partly loaded prime movers would simply involve applying first Case I and then Case II to see whether any additional power may be secured economically by further increasing the power-factor. The result would, of course, depend entirely upon conditions.

Example 1.—With $S =$ \$4, and a price of \$0.01 per kw-hour, 12 hours per day, 365 days a year, or $K =$ \$43.8, formula (8):

$$\tan\theta = \frac{4}{43.8} = 0.0913;\quad \cos\theta = 0.996$$

Example 2.—Assume a 45,000-volt, three-phase, two-circuit transmission line of No. 1 hard-drawn copper 66 miles long, and a total power at the plant of 9000 kw, 12 hours a day or a variable load equivalent to this, and let $S =$ \$4, and power 12 hours per day 365 days per year, 1.5 cents per kw-hour, or $K =$ \$65.7, then:

$w = 9000/6 = 1500$ kw,
$e = 26$ kv,
$r = 0.671 \times 10^{-3}$ kilo-ohms, and
$x = 0.295 \times 10^{-3}$
$l = 66$ miles.

From formula (17) there is obtained:

$$\tan\theta = \frac{26^2}{2\times 1500\times 0.671\times 10^{-3}\times 66}\,\frac{4}{65.7}$$

$$\tan\theta = 0.309;\quad \cos\theta = 0.955$$

This comparatively high value for the power-factor is due to the circumstance that the line is badly overloaded under the assumed conditions of load and price per kilowatt. With copper at 18 cents per pound, including transportation, and, in fact, all quantities varying with the weight of line material, one wire would cost per mile \$241. Allowing 7 per cent for interest this would amount to \$16.9 per annum. From equation (9) the loss per mile of wire at a power-factor of $\cos\theta = 0.995$ is:

$$L = \frac{1500^2\times 0.671\times 10^{-3}}{26^2\times .957^2} = 2.45 \text{ kw.}$$

According to Kelvin's law for the economical copper section the annual interest charge for copper must equal the cost of producing the energy annually lost in the line. This cost, of course, includes interest, depreciation and maintenance charges of the entire generating equipment, auxiliaries, buildings and everything depending directly upon the rated output of the plant. Assuming Kelvin's law to hold true in this case the cost of generating one kw-year would be:

$$\frac{16.9}{2.45} = 6.9;\text{ or } 0.158 \text{ cent per kw-hour.}$$

It would be quite unreasonable to suppose that energy was generated at such a small cost, particularly so when selling at a price of \$0.015 per kw-hour.

Doubling the copper-section of the line would involve an expenditure of \$95,400 for the entire line, and 7 per cent interest would amount to \$6,680 per annum. It would supply an additional load at the end of the line of $1.225\times 6\times 66 = 485$ kw. Supposing this could be sold at \$65.7 per kw-year, it would represent an income of \$31,860 per year; deducting the interest charge of \$6,680 leaves a profit of \$25,180, or 26.4 per cent upon an investment of \$95,400. And this would always be an acceptable profit whether or not it is less than the average profit of the entire plant.

RATES FOR HYDROELECTRIC SERVICE.

Discussion of the Conditions Determining the Rates Offered by Ten Transmission Companies.

By Alton D. Adams.

RATES for energy from hydroelectric plants reach values of less than 0.3 cent per kw-hour. So low a rate is secured by only a few consumers of large hydroelectric systems, but electric energy developed by water is sold as low as low as 2.0 cent per kw-hour by very small plants.

A reason for low rates with hydroelectric service is the fact that it is available during every hour of the day, and that large, long-hour consumers cannot be secured at higher prices.

To illustrate the scale of rates for electric energy developed by water the average prices per kw-hour obtained by a number of hydraulic plants during a recent year are here presented. In each case the average rate was determined by the division of the number of kw-hours sold into the total sum paid. Most of the plants considered supplement the water-power with steam, but in several instances only water is used to develop the energy.

Two classes of hydroelectric systems are here considered; one is devoted entirely to the sale of energy in bulk, so called, to only a few very large consumers, who use it for lamps and motors as they see fit, and resell for general consumption in some instances. The other class of hydroelectric systems, consisting mainly of the smaller plants, is devoted to the distribution of electricity for lamps and motors among consumers generally.

For the systems devoted to the sale of electrical energy in bulk the total number of kilowatts delivered to consumers is used to determine the average rate, but where a system is engaged in the general supply of energy for lamps and motors only the energy sold for motors and the resulting income are here considered.

The outputs of 10 hydroelectric systems are taken up in the above manner, and the number of kw-hours sold by each

ranged from 0.26 million up to 362 millions during the year. For the average rates the corresponding range is from 2.48 cents to 0.28 cent per kw-hour sold.

At the plant that sold 0.26 million kw-hours a general electric lighting and industrial service business is conducted, but the figures given relate only to the sales for motor service. The equipment of water-wheels at this plant was great enough to drive all of the electric generators, but the engine equipment was less than one-half that of the wheels, and most of the energy appears to have been developed with water, as only 60 tons of coal were used during the year.

In the plant that sold 1.6 million kw-hours at the average rate of 1.70 cents per kw-hour the combined engine and water-wheel rating is about equal to that of the electric generators, and of this combined rating the wheels represent 44 per cent. The 1.6 million kw-hours were sold for industrial purposes, and there was in addition a lighting load. Both coal and water-power generated substantial parts of the output of this plant.

The sale of 2.4 million kw-hours at 1.88 cents was made for industrial purposes only by a hydroelectric plant that also had a large lighting load. During the year the installation in both engines and generators at this plant was nearly doubled to care for increasing load, but at the beginning of the year the engine rating was about 2½ times that of the water-wheels. In spite of the much greater engine equipment, water-power was evidently used for generating a large part of the entire output, for the coal used during the year amounted to only 1.40 lb. per kw-hour delivered at the station switchboard, or only about one-third of the quantity often consumed per kw-hour in plants driven entirely with steam.

It may be noted here that where the rating of the engines of a steam-driven and water-driven electric plant is several times that of the wheels, the water-power may still generate the greater part of the energy output during the year because the engines are used mostly at times of maximum load.

The engine rating was double that of the water-wheels at the hydroelectric plant that sold 3.7 million kw-hours for motors only, at an average rate of 2.48 cents per kw-hour, and more than one-half of the output of this plant was sold for lighting purposes. Though the engine rating at this plant was twice that of the wheels, and the generator rating was about equal to that of the engines and wheels together, only 1.2 lb. of coal were consumed per kw-hour generated. It is probable, therefore, that from 50 per cent to 70 per cent of the total output for lighting and motor service in this instance was developed by water-power. No doubt a higher percentage of the 3.7 million kw-hours sold for industrial purposes was generated by water-power, being mainly the output of the day load.

Explanation of the high rate of 2.48 cents per kw-hour obtained by the system just considered is found in the existence of a large market for a limited amount of water-power.

Quite a different situation is presented by the hydroelectric system that was devoted to supply in bulk and sold its entire output of 18.2 million kw-hours to only eight customers, at the average rate of 0.82 cent per kw-hour. The generating station in this system operated in the main with water-power, the rating of the wheels being more than seven times as great as that of the steam engines, and the output was transmitted over distances up to some 20 miles to find markets. About one-fourth of the 18.2 million kw-hours was sold to large private consumers and the remainder to companies engaged in general electrical supply and to electric railways.

A system similar to the one just mentioned, but on a much larger scale, sold 53.7 million kw-hours at the average rate of 0.77 cent per kw-hour during the year, about 70 per cent of the energy going to large private consumers, mostly in the form of industrial plants, and the remainder to companies engaged in the distribution of electric energy for lamps and motors or in electric traction. No steam was used at this plant, and its output was developed entirely by water-power. Transmission distances from the plant to the several markets for the energy ranged up to more than 40 miles, and, like the previously mentioned system, it had the advantage of operating in a territory not saturated with water-power. This bulk supply of 53.7 million kw-hours included the entire sales of the hydroelectric system. In spite of the fact that this energy was sold at the average rate of 0.77 cent per kw-hour, it yielded a gross income of more than $418,000 for the year.

A still larger hydroelectric system registered 106.0 million kw-hours at its switchboard during the year, but the record of energy sold is incomplete. If it be assumed that the total efficiency of transmission was 80 per cent, 84.8 million kw-hours was delivered to the customers of this system at the average rate of 0.68 cent per kw-hour. The record is that 71.2 million kw-hours was sold to electric lighting and traction companies at the average rate of 0.58 cent per kw-hour, and if the assumed efficiency of 80 per cent for the transmission is correct, the remaining 13.5 million kw-hours, sold mostly to private customers, brought 1.1 cents per kw-hour.

In this instance the hydroelectric system is devoted exclusively to the sale in bulk of electric energy developed entirely by water-power, and its transmission lines cover a distance of more than 150 miles. The system supplies energy to 31 customers, including 18 lighting and traction companies, and derives more than three-fourths of its income from these companies. For the entire number of customers the average annual income was $18,624 from each, and for the 18 lighting and traction companies the average annual income was $23,590.

Another and larger system that supplied energy in bulk had a much greater number of customers—that is, 372—but the average income during the year per customer was only $2,702. From two lighting and traction companies served an average income was $284,736, and from the other 370 customers the average income was $1,313 each. The lighting and traction companies got their energy at the average rate of 0.609 cent per kw-hour, and the 370 other customers paid an average rate of 0.86 cent per kw-hour received. For this system the entire sales of energy amounted to 149.7 million kw-hours during the year, at the average rate of 0.704 cent per kw-hour. All of the energy sold by the system now under consideration was generated by water-power and then transmitted more than a score of miles to the markets.

Coming to the largest hydroelectric system in the world, in point of generating rating and output, it appears that 362 million kw-hours was sold during the year under consideration, yielding a total revenue of $1,008,818.04, or 0.2786 cent per kw-hour. This was distinctly supply in bulk, for only 33 customers contributed to this total revenue. Of the above total sales only about 40 million kw-hours, or 11 per cent, was delivered to lighting and traction companies, while nearly 322 million kw-hours was delivered to other customers. The sales to electric and traction companies were at the average rate of 0.382 cent per kw-hour, while the income from sales to other customers was only 0.2658 cent per kw-hour. This 322 million kw-hours was used mainly for electrochemical purposes. Nothing but water-power could make these last-mentioned rates possible, and water-power was the only source of energy in this hydroelectric system.

For purposes of ready comparison the above figures are arranged in a table, and a corresponding diagram is presented for the five systems that sell only in bulk.

ANNUAL SALES AND AVERAGE RATES OF HYDROELECTRIC SYSTEMS.

Million kw-hours sold during the year.	Average rates in cents per kw-hour sold.
0.26	2.05
1.6	1.70
2.4	1.88
2.9	1.42
3.7	2.48
18.2	0.82
53.7	0.77
84.8	0.68
149	0.704
362	0.2786

As may be noted on inspection of the table and diagram the average rate decreased with the volume of sales. Taking the five smaller plants that did a general lighting business besides the sale of electricity for motors, four of these plants show a nearly uniform decrease of average rate per kw-hour with the

increase of output, but the plant that sold 3.7 million kw-hours obtained a higher rate because of the relatively small amount of water-power that was available for sale in a large market. A striking feature with these small plants is the sale of from 1.6 million to 2.9 million kw-hours at rates below 2 cents on an average.

For the five plants that sold hydroelectric energy in bulk only, and whose total outputs are given, the energy delivered to customers during the year ranged from 18.2 million kw-hours to 362 million kw-hours, and the average rates from 0.82 cent to 0.28 cent per kw-hour. Omitting for the moment the plant that sold 362 million kw-hours, it is to be noted that the average rates at each of the other four plants ranged from about 0.68 cent to 0.82 cent per kw-hour, or over some 0.12 of a cent,

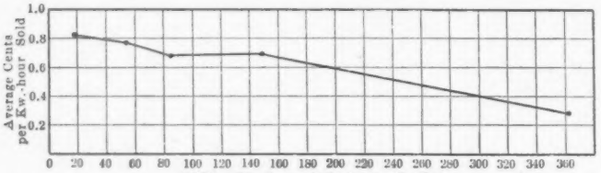


Diagram Showing Average Rates for Hydroelectric Service.

while the greatest was more than eight times the least output. These four hydroelectric systems may be said to represent approximately the rates that were necessary to displace steam power in their respective territories among large, long-hour users.

At the plant that sold 362 million kw-hours the average rate of nearly 0.28 cent per kw-hour represents competition of the broadest sort; that is, the competition necessary not only to displace all steam power, but also to draw large customers from other parts of the country, and to build up by cheap energy industries that could not otherwise exist. It is to be noted that this rate of about 0.28 cent per kw-hour is only from one-third to one-half of the rates of the four plants that sold in bulk at prices that displaced steam power.

All of the 10 hydroelectric plants under consideration, and especially the five that sold energy only in bulk, present the strong characteristic of supply from water-power; that is, low average rates resulting from large supply powers available every hour in the day and pressing for markets at some price.

PRODUCER-GAS POWER PLANTS.

Economy of Operation and Installation Cost Data.

A bulletin recently issued by the United States Geological Survey forms a valuable contribution to the subject of producer-gas power plants, the author being Mr. Robert Heywood Fernald, who had previously considered the same subject in bulletins issued in 1906 and 1907. The report is very favorable to the gas-producer power plant. One of the conclusions is that the time is not far distant when financial interest in power production will be directed toward the centralization of producer-gas power plants at mines, and the distribution of the energy developed, either by high-voltage, long-distance electric transmission, or by pipe systems for conveying the gas. The report, which is throughout very favorable to the gas-producer power plant, includes the following table of comparative results obtained at the St. Louis Government testing plant from 75 bituminous and 6 lignite coals, used in the gas producer and also under the steam boiler. The third and fourth columns give the total pounds of coal per electrical horse-power per hour generated at the switchboard from steam generation and producer-gas generation respectively.

The author calls especial attention to the fact that several low-grade coals and lignites that have proved of little value or even worthless under the steam boiler have given excellent results in the gas producer. The ratios of the total fuel per brake-horse-power hour required by the steam plant and producer-gas plant, under full load, not counting stand-by losses, are presented below as derived from 75 coals, 6 lignites and 1 peat (Florida).

While the steam engine used in these tests was of the simple type, the author states that in considering the possible increase

TABLE I.

Total Pounds of Coal as Fired per Electrical Horse-Power per Hour Developed at the Switchboard, for both Steam and Producer-Gas Plants.

Fuel used.	Locality.	Steam.	Producer gas.	Ratio.
Alabama No. 2	Carbon Hill	4.29	1.71	2.51
Colorado No. 1	Lafayette	6.04	2.14	2.82
Florida (peat) No. 1	Orlando	..	3.03	..
Illinois No. 3	Marion	4.74	1.93	2.46
Illinois No. 4	Troy	5.47	2.01	2.72
Illinois No. 6	Coffeen	6.28	2.02	3.11
Illinois No. 7	Collinsville	5.21	2.41	2.16
Illinois No. 8	Paisley	6.26	1.98	3.16
Illinois No. 9	Staunton	5.22	2.01	2.59
Illinois No. 10	West Frankfort	4.88	1.59	3.07
Illinois No. 11	Carterville	4.35	1.37	3.18
Illinois No. 13	Benton	4.17	1.74	2.40
Illinois No. 14	Springfield	5.27	1.79	2.94
Illinois No. 15	Centralia	4.61	1.80	2.56
Illinois No. 16	Herrin	4.24	1.81	2.34
Illinois No. 18	La Salle	4.53	1.74	2.61
Illinois No. 19	Zeigler	4.09	1.47	2.78
Indiana No. 1	Mildred	4.95	2.17	2.28
Indiana No. 2	Boonville	4.78	1.68	2.85
Indiana No. 3	Boonville	4.92	1.97	2.50
Indiana No. 5	Hymera	4.74	1.51	3.14
Indiana No. 6	Hymera	4.78	1.94	2.46
Indiana No. 7	Littles	4.09	1.65	2.66
Indiana No. 8	Terre Haute	4.52	1.61	2.81
Indiana No. 9	Macksville	4.63	1.84	2.52
Indiana No. 11	Dugger	4.37	1.73	2.53
Indian Territory No. 1	Henryetta	4.37	1.92	2.28
Indian Territory No. 4	Lehigh	4.95	1.57	3.15
Iowa No. 2	Marion County	5.82	2.07	2.81
Kansas No. 5	West Mineral	4.11	1.57	2.62
Kentucky No. 1	Straight Creek	3.72	1.41	2.64
Kentucky No. 3	Earlington	4.58	2.05	2.24
Kentucky No. 5	Big Black Mountain	3.54	1.39	2.55
Kentucky No. 6	Paintsville	3.68	1.33	2.77
Kentucky No. 7	Central City	4.36	1.65	2.64
Missouri No. 2	Bevier	5.44	1.94	2.80
Montana No. 1	Red Lodge	..	2.54	..
North Dakota No. 1	Lehigh	10.09	2.82	3.87
North Dakota No. 2	Williston	..	3.80	..
North Dakota No. 2	Williston	..	2.83	..
North Dakota No. 3	Wilton	8.46	3.24	2.61
Ohio No. 3	Shawnee	4.27	1.51	2.83
Ohio No. 4	Bradley	3.98	1.34	2.97
Ohio No. 5	Bush Run	3.96	1.26	3.14
Ohio No. 6	Neffs	4.00	1.30	3.08
Ohio No. 7	Danford	4.16	1.67	2.49
Ohio No. 8	Dixie	4.25	1.56	2.72
Ohio No. 9	Clarion	3.91	1.43	2.73
Pennsylvania No. 4	Greensburg	3.63	1.42	2.56
Pennsylvania No. 5	Ellsworth	3.52	1.28	2.75
Pennsylvania No. 6	East Millsboro	3.83	1.23	3.11
Pennsylvania No. 7	Ligonier	3.88	1.68	2.31
Pennsylvania No. 8	Ehrenfeld	3.43	1.28	2.68
Pennsylvania No. 10	Bruce	3.55	1.32	2.69
Texas No. 1	Crockett	..	3.34	..
Texas No. 2	Hoyt	..	2.58	..
Virginia No. 1	Crab Orchard	3.66	1.53	2.39
Virginia No. 2	Crab Orchard	3.58	1.38	2.59
Virginia No. 3	Toms Creek	3.57	1.21	2.95
Virginia No. 4	Darby	3.56	1.31	2.72
West Virginia No. 1	Kingmont	3.98	1.60	2.49
West Virginia No. 4	Bretz	3.71	1.32	2.81
West Virginia No. 7	Sun	3.65	1.50	2.44
West Virginia No. 8	Ansted	3.83	1.82	2.10
West Virginia No. 9	Powellton	3.58	1.43	2.50
West Virginia No. 12	Big Sandy	3.59	1.53	2.35
West Virginia No. 13	Page	3.45	1.04	3.32
West Virginia No. 14	Page	3.41	1.10	3.10
West Virginia No. 18	Glen Alum	3.43	1.20	2.86
West Virginia No. 20	Acme	3.46	1.31	2.64
Wyoming No. 2	Cambria	6.64	2.28	2.91
Wyoming No. 2	Cambria	5.64	2.28	2.47
Wyoming No. 3	Aladdin	5.35	2.04	2.62
Brazil No. 1	Porto Alegre	6.43	2.60	2.47

Average ratio, coal as fired per brake-horse-power hour under boiler to coal as fired per brake-horse-power hour in producer	2.7
Maximum ratio, coal as fired per brake-horse-power hour under boiler to coal as fired per brake-horse-power hour in producer	3.7
Minimum ratio, coal as fired per brake-horse-power hour under boiler to coal as fired per brake-horse-power hour in producer	1.8
Average ratio, lignite and subbituminous coal as fired per brake-horse-power hour under boiler to lignite as fired per brake-horse-power hour in producer	2.7
Maximum ratio, lignite and subbituminous coal as fired per brake-horse-power hour under boiler to lignite as fired per brake-horse-power hour in producer	2.9
Minimum ratio, lignite and subbituminous coal as fired per brake-horse-power hour under boiler to lignite as fired per brake-horse-power hour in producer	2.2
Average ratio, peat as fired per brake-horse-power hour under boiler to peat as fired per brake-horse-power hour in producer	2.3

in efficiency of a steam test with a compound engine, the fact should not be overlooked that a corresponding increase in the efficiency of the producer-gas test may be brought about under correspondingly favorable conditions. The gas producer used in these tests is rapidly becoming obsolete, and changes and improvements are constantly being made which tend to increase

the efficiency of the gas engine. The conclusion is that while the comparison of the producer-gas plant and steam plant used in the tests is very favorable to the former, any increase of efficiency in the steam tests that might result from using a compound engine can be offset by the introduction of a gas engine of some modern type and a producer plant designed to handle the special kinds of fuel used.

The report gives the accompanying tables of the cost of gas-engine and gas-producer plants. It is stated that for the larger plants, say, from 4000 hp to 5000 hp, the cost is about the same as that of first-class steam plants of the same rating. For smaller installations the balance is as yet in favor of the steam plant, but it should not be forgotten that the increased efficiency in operating the latter will make up the deficiency in the first cost within a short time.

TABLE II.

Cost per Horse-Power of Producer-Gas Installations.

Horse-power.	Gas producer and engine erected, exclusive of foundations.	Gas producer and engine erected, including foundations.	Complete plant, exclusive of buildings.*	Complete plant, including buildings.*
20	$105.00	$108.50	....	....
25	62.50	....	....	....
25	115.00	....	....	....
50	86.00	....	....	....
60	69.50	74.50	....	....
75	75.00	....	....	....
75	86.50	....	....	....
80	62.00	....	....	....
100	67.00	....	....	....
110	60.50	68.00	....	....
110	62.50	....	....	....
125	65.00	....	....	....
125	90.00	....	$100.00	....
150	70.00	....	....	....
200	67.00	....	....	....
250	65.00	68.00	79.00	$93.00
300	58.00	....	....	....
500	....	....	84.40	....
1000	55.50	....	69.50	79.50
2000	46.00	47.50	56.50	63.50
2800	....	....	....	76.00
4000	....	....	....	69.00
4000	....	....	....	72.00
4000	....	....	....	77.50
4800	....	....	....	72.00
4800	....	....	....	79.50
5500	....	....	....	70.00

* Includes producer, engine, electric generator, piping and auxiliaries, all erected, with suitable foundations.

A valuable feature of the report consists of a series of notes giving the result of observations made in visits to 69 producer-gas power plants; following which is a table giving the data of more than 500 producer-gas power installations in the United States.

Among the subjects discussed in the report are reliability of operation, skill required of engineers operating such plants, overrating selection of coal, etc. In this latter connection it is stated that investigations of the Geological Survey have demonstrated that, without question, both the up-draft or pressure producer, and the down-draft type will generate an excellent gas from bituminous coals suitable for the commercial operation of gas engines. While some difficulties have been encountered in adapting the gas producer to bituminous and lignite coal, it is stated, nevertheless, that 57 per cent of the total producer-gas horse-power in this country is developed from bituminous coal and lignite.

TABLE III.—COST OF PRODUCER-GAS ENGINES.

Horse-power.	Cost per horse-power—Cost f.o.b. factory.	Cost of erecting.	Foundation, Cubic feet.	Cost of foundation.	Cost of engine erected, including foundation.	F.o.b. factory.	Erected, not including foundation.	Erected, including foundation.
20	$1,100	....	...	$50	$1,150	$55.00	....	....
55	....	....	...	...	2,400	....	....	$43.70
60	2,800	....	350	105	....	46.70	....	....
60	2,900	....	...	150	....	48.40	....	....
75	3,610	$175	375	150	3,933	48.10	$50.50	52.40
80	....	....	...	...	3,300	....	....	41.20
80	3,400	....	...	...	....	42.50	....	....
80	3,250	....	...	...	....	40.70	....	....
80	3,830	....	...	...	....	47.90	....	....
85	4,150	....	...	...	....	48.90	....	....
85	3,550	....	...	...	....	41.80	....	....
100	4,300	....	...	...	....	43.00	....	....
100	4,925	....	...	...	....	49.25	....	....
110	4,950	....	...	225	....	45.00	....	....
110	4,960	....	...	...	....	45.10	....	....
110	5,100	....	...	...	....	46.30	....	....
112	4,200	....	...	...	....	37.50	....	....
125	5,450	....	...	...	....	43.60	....	....
130	5,250	....	...	...	....	40.40	....	....
135	6,600	....	...	...	....	48.90	....	....
150	6,200	....	...	...	....	41.30	....	....
160	5,500	....	...	...	....	34.40	....	....
160	6,100	150	2,000	520	6,770	38.10	39.00	42.30
185	7,800	....	...	...	....	42.20	....	....
210	8,600	....	...	...	....	40.90	....	....
250	6,650	150	2,160	560	7,360	26.60	27.20	29.40
300	10.500	....	...	...	....	35.00	....	....
400	12,000	....	...	...	....	30.00	....	....
400	12,800	....	...	...	....	32.00	....	....
600	17,400	....	...	...	....	29.00	....	....
1,000	33,750	300	...	...	....	33.75	34.00	....
2,000	64,850	875	5,400	1,400	67,125	32.43	32.86	33.56

Central Station

Management, Policies and Commercial Methods

EDUCATION IN ILLUMINATION.

The Montgomery (Ala.) Light & Water-Power Company is conducting a vigorous campaign for new business. On Feb. 2 the citizens were invited to attend a lecture at the Grand Theater on "Illumination," to be delivered by Mr. F. Laurant Godinez, who, according to the card of invitation, presented "many sensational and spectacular experiments in electricity, including stereopticon pictures showing the proper and improper arrangement of lights in the home, store and public buildings." The company is operated by H. L. Doherty & Company, of New York, for whom Mr. George Williams is conducting the advertising campaign.

ELECTRIC POWER SUPPLY TO FARMERS NEAR LA PORTE, IND.

The La Porte Electric Company, of La Porte, Ind., has a 6600-volt, single-phase, 125-cycle transmission line from La Porte to the small neighboring town of Westville. Such transmission lines are not unusual, but the interesting thing about this line is the number of farmers who are supplied from it. There are on this line 13 farmers and one small village in addition to the town of Westville at the end which are supplied from seven transformers which step down from 6600 volts to 110 volts. The secondaries are all grounded as a safety precaution. Some of these transformers are as small as 1 kw, although Mr. J. H. Harding, president and manager, would not recommend the purchase of such small transformers for such voltages for a new line. He thinks 2 kw is small enough. The arresters used are Westinghouse jump-spark, carbon-bridge type. No trouble has been experienced from lightning the year this line has been in operation. This is a very inexpensive type of arrester as compared with those which frequently are thought necessary for lines of such voltage. As the cost of lightning arresters has been one of the most serious deterrents from the building of lines to supply numerous farmers, this experience at La Porte is of considerable interest.

AUTOMOBILE MAP FOR ELECTRIC-VEHICLE OWNERS.

The Commonwealth Edison Company, of Chicago, is distributing to owners of electric vehicles in that city a very convenient automobile map of Chicago. This map, which is folded up to a size convenient to the pocket, is printed on a large scale in four sections and is provided with a numbered key

so that automobile drivers may ascertain while out on the road the nearest charging stations for electric vehicles. Thus, should the charge in the battery run low, the driver may see at a glance the nearest station where he can replenish his supply of electricity so that he may proceed to his destination. The map, which is on the scale of 2½ in. to a mile, also indicates the good roads or streets or the roads which are fair in dry weather. Furthermore, the street numbers are indicated by marginal references, and the principal automobile roads leading out of the city are also shown. The map is folded up in a cover, and a few pages are added in relation to the charging of electric vehicles, the care of vehicle batteries and the advantages of the electric delivery wagon. It is sent out to electric vehicle owners with the compliments of the Commonwealth Edison Company, and its usefulness will be appreciated by every operator of electric pleasure vehicles or power wagons in the city.

COMPETITION OF THE TUNGSTEN WITH GAS.

In a paper presented at a recent meeting in Indianapolis of the Indiana Gas Association tungsten lamp competition was a subject of considerable discussion. In this connection the necessity was urged of managing gas plants economically and looking carefully after the by-products. One of the speakers stated that the tungsten had become a strong competitor with gas, and that in consequence the gas people must be on the alert to give the merchants more light, together with an ornamental installation. He stated that the talking points of the electric man against gas lighting are the heat, inconvenience and lack of ornamentation, but he believed that the inverted type of gas arc would meet the latter objection. It was advised that gas arcs should be sold outright, for the reason that if a customer has made the investment he will be less apt to discontinue it in favor of the tungsten. On the other hand, he said that the gas arcs should be maintained under contract even if sold outright. Another speaker told of the necessity for cheaper gas fixtures to compete with cheap electric fixtures. One of the speakers made the extraordinary claim that, in addition to the better distribution of light from the use of gas, the atmosphere in large stores and public halls is much better when lighted with gas than when lighted by electricity. Another claim was made that the fumes from gas are beneficial in warding off some diseases, such as diphtheria, and that these fumes also are an efficient disinfectant. There appears to be a contradiction between the one statement as to the purity of the atmosphere where gas is used and the other statement as to loading the atmosphere with fumes for disease prevention and disinfection.

RATES OF THE HYPOTHETICAL ELECTRIC COMPANY.

At a recent meeting of the Milwaukee Association of Bookkeepers and Accountants, Mr. W. J. Hagenah, chief statistician of the Wisconsin Railroad and Public Service Commission, discussed, among other things, the proper methods of arriving at rates of an electric light and power company which he called "the Hypothetical Electric Company." He pointed out that the expenses of a public utility of this kind are divisible into two classes, namely, the fixed expense, which is not proportionate to plant output, and variable expense, which changes and fluctuates with the output. He assumed the case of a plant which he considered as typical of one of average size. The assumed plant value is $100,000, and the capacity of the plant 400 kw, the value, therefore, being $250 per kilowatt. He assumed fixed expenses not proportionate to the output at 16 per cent of the value, or $16,000. Variable expenses he assumed at 2 cents per kw-hour. With the maximum possible output, that is, with 100 per cent load factor, the output would be 400 kw times 24 hours time 365 days, or 3,504,000 kw-hours. With this load factor the fixed expense would be $16,000 divided by 3,504,000 kw-hours, or .456 cent per kw-hour. The variable expense of 2 cents per kw-hour would, therefore, bring the total expense up to 2.456 cents per kw-hour.

At 4.17 per cent load factor the fixed expenses would equal $16,000 divided by 146,000 kw-hours, or 10.958 cents per kw-hour. The variable expense of 2 cents per kw-hour added to this would give a total expense of 12.958 cents per kw-hour with 4.17 per cent load factor. Using these figures as a basis, Mr. Hagenah gave the accompanying table showing the cost per kw-hour with various load factors or a various number of hours' use per day. Although this information is not by any means new to those central-station men who have studied the economics of the business, it is interesting as showing the recognition by such men as Mr. Hagenah of the high cost of supplying consumers who use electricity for a short time each day as compared to those who use it over a large part of the day.

TABLE OF EXPENSE PER KW-HOUR AT DIFFERENT LOAD FACTORS.

Average daily hours' use.	Kw-hour output.	Load factor.	Fixed expenses per kw-hour output. cents.	Variable expense, cents.	Total, cents, per kw-hour.
Quarter hour.....	36,500	1.04	43.84	2	45.84
Half hour.....	73,000	2.08	21.92	2	23.92
One hour.....	146,000	4.17	10.96	2	12.96
Two hours.....	292,000	8.34	5.48	2	7.48
Three hours.....	438,000	12.50	3.64	2	5.64
Five hours.....	730,000	20.80	2.19	2	4.19
Eight hours.....	1,168,000	33.33	1.369	2	3.37
Ten hours.....	1,460,000	41.66	1.09	2	3.09
Sixteen hours.....	2,336,000	66.66	.685	2	2.68
Twenty-four hours..	3,504,000	100.00	.456	2	2.45

THE TECHNICAL MAN IN CENTRAL STATIONS.

Prof. C. M. Jansky, who has charge of the technical correspondence-school work of the University of Wisconsin, has recently been attempting to compile some figures relative to the technical training of central-station employees and its bearing on the efficiency of the central-station organization. At a meeting of the Wisconsin Electrical Association, held at Waupaca, Wis., in June, 1909, Professor Jansky presented some information about the correspondence work of the university in the training of employees in various industries. At that time the point was raised that some employers are narrow-minded enough to object to educating their employees because they think it will make them dissatisfied and will result in their going to better positions, leaving the company to train new men. However, those taking part in the discussion did not approve of this attitude on the part of the employer; in fact, the general sentiment was that the managers present were men who were developing and improving rather than standing still. One quoted the sentiment expressed by Mr. Paul Lupke at the N. E. L. A. convention in 1909 to the effect, "Who wants a man that no one else wants?"

Professor Jansky would not have raised this point again but for the fact that since the discussion spoken of the manager of a large manufacturing company opposed the education of his employees on the same ground. Professor Jansky was considerably surprised that managers could believe that a profit could be made on the ignorance of their employees. To investigate this matter as regards central stations he sent out 100 inquiries to central stations in Wisconsin. He got 50 replies from the 100 central stations—a very good percentage. The total number of men employed in central stations replying was 200. Of these 13 had received a college education, either technical or literary; six had made special preparation for the work they were doing. In one plant the man in charge of the boiler-room has had two years' college training. In another station the electrician is a technical graduate. The general trend of the answers expressed the sentiment that more education is desirable, and the desire to get this education is indicated by the number who have taken to correspondence work. Those who have taken correspondence work are as follows: Superintendents, 16; engineers, 5; electricians, 9; boiler-room men, 1.

In connection with this inquiry Professor Jansky had hoped

to take the answers as to the number of technical graduates employed by the various central-station companies and compare these with the reports on cost of production filed with the Wisconsin Public Service Commission. He found the reports of the smaller companies in such imperfect condition, however, as to make this almost impossible. The reports from these smaller companies indicated a deplorable lack of system in the management. He found two companies, however, where apparently the training of the men in charge of the plant had something to do with the efficiency. These plants were in towns of almost identically the same size. One of these, with an output of 240,807 kw-hours per year, has a coal consumption of 13.9 lb. per kw-hour. The second plant, with an output of 112,123 kw-hours per year, has a coal consumption of 8.25 lb. per kw-hour. The price of coal is nearly the same in the two cases. The former plant had no employee with technical training, while the latter had two college men, one the superintendent and the other the meter man.

Professor Jansky points out that the time has gone by when any business organization can be run by rule of thumb. In this connection he makes the pertinent observation that an accounting system is of no use if the manager for whose information these accounts are kept does not know the proper relation of the physical quantities involved. For example, the manager must know what the fuel consumption of his plant should be, if properly operated without leaks, in order to know whether the results he is obtaining are good or bad. Bookkeeping which shows the difference between energy generated and energy sold will be of no value to the manager unless he knows what is a reasonable loss of energy under his conditions.

He suggests, as the principal amount of information which should be contained in the daily report of the small central station, the following items:

A, total daily energy output; B, average load for day; C, minimum load for day; D, maximum load for day; E, total water consumption for day; F, total water evaporated for day; G, total fuel consumption; H, periods of operation of various machines. From these records should be calculated each day the pounds of coal per kw-hour and the pounds of water evaporated per pound of coal.

SPECIAL HOUSE-WIRING CAMPAIGNS AMONG THE BYLLESBY COMPANIES.

Mr. E. L. Callahan, manager of the new-business department of H. M. Byllesby & Company, of Chicago, which firm controls and operates 31 gas and electric companies in various parts of the country, has recently been putting through a campaign for the wiring of small houses which will be of interest to a large number of central-station managers. This plan has been put into effect in all of the plants controlled by Byllesby & Company. In Mr. Callahan's opinion it is much better than plans where the lighting company goes into the wiring business itself and runs the risk of considerable loss in collecting for the wiring, probably losing the good-will of some consumers thereby.

Mr. Callahan found that even in Western cities many residences were not wired and that the company's solicitors were not able to secure the majority of these through hard work. Only part of the companies controlled do wiring. The wiring and sale of energy-consuming appliances are handled by contractors. Mr. Callahan went to these contractors and told them that the lighting company would bear the expense of advertising and furnishing solicitors to secure consumers in residences not then wired; and in order to accomplish very much it was necessary for the contractor to make a specially low price on the wiring of these houses. This low price would hold only for a limited time. The central station would turn over orders for the wiring of houses secured by its solicitors to the contractors who made the lowest bids on the work. These figures were secured from the contractors and the results during the past two months have been very satisfactory. These low prices were advertised as a special proposition which would be offered for a limited time only.

A five-room, one-story or story and a half bungalow was taken as the basis for figuring. In one of the cities in question the contractor named a price of $9.95 for completely wiring and equipping a five-room house with lamp-cord drops, not including lamps. In the central-station company's advertisements, which are given later, it will be seen that several propositions were advertised using fixtures. In most cases the Tungstolier Company's line of fixtures was used, the central-station company securing for the contractor a satisfactory price on these. The prices for wiring were made on the understanding that cash would be paid. When the contractor found that a customer had a good record, he used his discretion about giving time in paying for the wiring. When the central-station company's solicitors secured these wiring contracts for the contractors they also secured the customers' signatures to applications for electric service.

It is the intention to continue this special campaign for two or three months; then it will be stopped for the reason that it is not desired permanently to establish prices for wiring which will be so low that the contractors in the various towns will suffer loss in the long run. Mr. Callahan reports that the wiring contracts secured by the central-station solicitors and handed to the contractors without cost for soliciting or advertising netted the contractors a profit of from $2 to $10 a house and seemed to be satisfactory to the contractors. The central stations have added to their residence consumers from 10 per cent to 15 per cent in two months' time.

Later these same solicitors will go over the residence districts again, taking note of the electric installations and asking whether the service is satisfactory. This is to secure, if possible, additional lighting business through the installation of a porch lamp socket in the kitchen for the flatiron, closet lamps and hallway lamps. They will also at this time, or during a third canvass, endeavor to sell flatirons and other heating devices. In this way the companies will get into closer touch with their residence consumers, secure more profitable business from them and cultivate their good-will.

Following is the wording of advertisements which have appeared in two of the towns in which this campaign has been carried on. As printed, the announcements, of course, are in the usual advertising display form. In some cases it has been thought advisable to advertise this special proposition over the name of the contractor giving the lowest figures. In others the central station has advertised over its own name.

One of these advertisements from Muskogee is as follows:

A special offering that will make it possible for everyone in Muskogee to enjoy the luxury of electric light at a minimum cost.

We have completed arrangements with a large fixture manufacturing concern by which anyone on the lighting company's electric lines, or near enough to permit of extensions, can take advantage of the greatest offer of the kind ever made to the public.

Proposition A.—You can have a five-room house wired for electric drop lights, complete with six cord drops and three ornamental glass shades (living-room or parlor, dining-room, two bedrooms, kitchen, bath or hall), all for $13.89 (regular price, $30). Six 16-cp lamps, extra, $1.20.

Proposition B.—Same as *Proposition A*, except as follows: Living-room or parlor, two-light fixture; dining-room, two-light fixture; kitchen, one pendant light; two bedrooms, one drop light each; bath or hall, one pendant light. All for $18.89 (regular price, $40). Eight 16-cp lamps, extra, $1.60.

Proposition C.—You can have a five-room house wired and equipped with the latest design fixtures—something new—complete with seven ornamental glass shades, an eight-light installation, with a new and special switch on each lamp socket. Living-room or parlor, one two-light fixture; dining-room, one two-light fixture; kitchen, one pendant light; two bedrooms, one drop light each; bath or hall, one pendant light.

All for $22.50 (regular price, $50). Eight 16-cp lamps, extra, $1.60.

Proposition D.—You can have a five-room house wired and equipped complete as offered under *Proposition C,* excepting the addition of fixtures noted below, and the substitution of square-tubing fixtures and canopies and husk design of socket for the round effect. A very rich, ornate design with 5-in. "square roughed inside" cut-glass shades: Living-room or parlor, two-light fixture; dining-room, two-light fixture; kitchen, one pendant fixture; two bedrooms, each, one pendant fixture. Bathroom or hall, one pendant fixture. All for $27.50 (regular price, $60). Eight 16-cp lamps, extra, $1.60.

Proposition E.—The same as *Proposition D* with the substitution in the dining-room of a 26-in. dome for use of tungsten lamps with brush brass chain hanger, and in the living-room an elegant design in four-light fixtures instead of two-light. All for $32.75. Eight 16-cp lamps, extra, $1.60; one 60-watt tungsten lamp, extra, $1.25.

Think of it, the above prices are less than half the best bargain prices ever offered in any city. You have your choice of brush brass or rich cloister (oxidized bronze) finish. We have the above described fixtures on display, and have a large stock of all styles. Display-rooms will be kept open every night. Seven years of successful business in Muskogee is our record. Reasonable prices. Prompt service. High-grade work has always been our aim. Now is your opportunity. Have your home healthfully and beautifully illuminated.

Remember, this offer is for a limited period only.—The Muskogee Electric Company.

TUNGSTEN LAMPS IN OUTLYING STREETS IN DES MOINES.

The Des Moines Electric Company is now supplying 812 series tungsten 40-cp lamps for lighting the outlying streets of Des Moines, Ia. These replace 32-cp carbon lamps, which were formerly used. The rate is $17.04 per year per lamp for all-night every-night service. The lamps consume 6.6 amp.

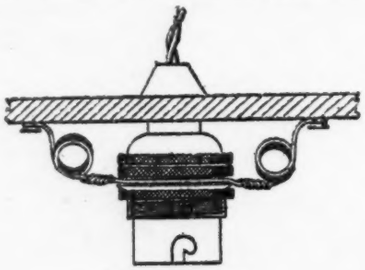
TUNGSTEN LAMP INCREASES STATION OUTPUT.

In their annual report the directors of the Narragansett Electric Lighting Company, of Providence, R. I., call attention to the manner in which the less demand for electrical energy of the tungsten lamp has not only been counteracted, but the lighting load considerably increased through their use. In order to avoid a reduction in output which it was thought might be incident to the introduction of tungsten lamps owing to their high economy, a strong "new-business" campaign was organized, additional solicitors engaged and advertising largely increased. As a result, nearly 17,000 tungsten lamps were placed on the circuit. The increase of business, together with the prospect of continued increase, caused the installation of a 3500-kw turbo-generator in the South Street station of the company, and a 1000-kw motor-generator in the Dyer Street substation. The report further states that the sale of small heating appliances has been the cause of an increase of load equivalent to 10,388 16-cp lamps. It is stated that over 6 per cent of the residence customers of the company now use the electric flatiron.

Wiring and Illumination

SHOCK-ABSORBER FOR METALLIC-FILAMENT LAMPS.

Lamps fastened to the flat side of a board are subjected to vibrations of very high frequency whenever the board receives a shock, due to the high natural period of vibration of a flat body in the direction perpendicular to its surface. Even under ordinary conditions trouble is experienced with breakage of metallic filaments due to vibrations, and various kinds of flexible fixtures have been designed to absorb such vibrations by increasing the natural period of the fixture and relieving it of the obligation of following the vibrations of the body to which it is fastened. The device shown in the accompanying illustration was recently put on the English market. It is extremely simple and particularly well adapted to use with sockets fastened to the flat side of a board and are therefore subjected to extremely high frequency vibrations. Such methods of suspension are most often used in stage and temporary work.



Shock Absorber.

FIRE AND FOOL-PROOF FUSE HOLDERS.

There has recently been developed in Europe a new type of fuse holder designed along rational lines after a painstaking study of the requirements of fuses for small installations. Fig. 1 shows a cross-section of the fuse holder. It consists of four essential parts—the base, the gage ring, the cartridge and the cap. The device is fireproof, as all contacts and connections are enclosed in the porcelain base, and the fuse is entirely enclosed in a strong porcelain cartridge. Extensive tests demonstrate absolute freedom from fire risks.

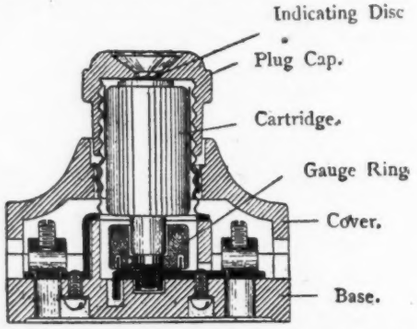


Fig. 1.—Cross Section Through Fuse and Holder.

The holder is rendered fool-proof by a scheme that is both simple and certain. It is impossible to replace a burned-out fuse by any except one of the same ampere and voltage rating.

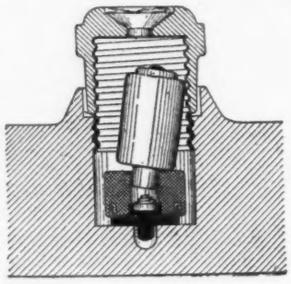


Fig. 2.—Effect of Putting in a Wrong Fuse.

The diameter of the cartridges is greater, and the recess in the gage ring is deeper for the 500-volt than for the 250-volt fuses. Fig. 2 shows what would happen if it were attempted to replace a 500-volt fuse by one for 250 volts. The ampere rating determines the diameter of the recess in the gage ring. To facilitate

the work of replacing a burned-out fuse the ampere rating is indicated by a color, and the fuse and gage ring are made the same color, so that one has simply to pick out a fuse of the color corresponding to that of the ring. The ring can only be removed by a special socket tool that is kept by the central-station company, thus putting in its hands the control of the size of fuel to be used. The colors are not only of value when replacing burned-out fuses, but they also serve as indicators at

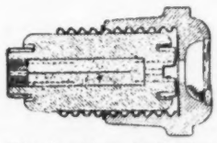


Fig. 3.—Fuse Indicator.

all times, since the head of the cartridge is always visible through the glass window in the cap. A blown fuse is indicated in a very novel and striking manner. Each fuse carries in its outer end a black button attached to a spring, which is connected to the fuse circuit in such a way that the burning of the fuse releases the spring and the button falls out, as shown in Fig. 3. A fuse in operative condition shows a black bulls-eye surrounded by a colored ring, which indicates its ampere rating, and a blown fuse shows the black button lying in the lower side of the cap, thus making a very striking contrast with the normal condition. The caps are provided with standard Edison base threads and are made in three sizes—small, normal and large thread. With this device any person can replace a burned-out fuse with perfect confidence that it will be properly done and without fear of a shock. The arrangement permits the central station to choose the size of a fuse and rest assured that no other size can be used without its consent.

SPECTACULAR STAGE LIGHTING AT THE CIRCUS SCHUMANN, BERLIN.

The extensive use made of electricity in the modern drama is well exemplified in the pantomime "The Three Rivals," presented at the Circus Schumann in Berlin, Germany. Not only is the stage arranged in eight separate parts, each of which can be independently raised or lowered by electric motors, but there is a revolving stage as well, permitting scenic changes to be made in a minimum time.

Electrical effects are produced in some of the acts which are unique. In the castle of the hero, the "Knight of Champagne,"

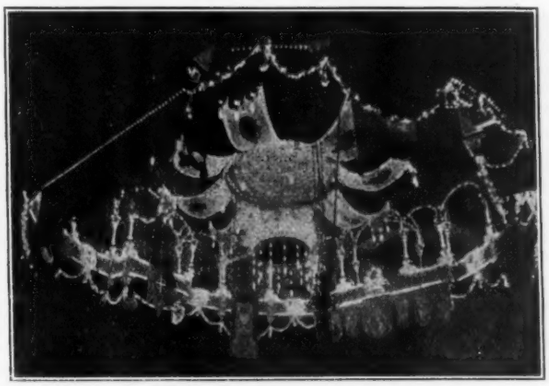


Fig. 1.—Canopy of 17,000 Vari-Colored Lamps.

red flames, made by projecting electric light through fluted ribbons, burn on the candlesticks. Under the columns of the palace standing on pedestals are gold bespangled maidens and pages carrying beautiful candlesticks giving the appearance of living candelabra. In the dance of the wines, which follows the rising of the curtain, nymphs of Bacchus, their hair decked with grape leaves, bear in their arms golden, red and green glowing clusters of grapes. The revelry and joy-making reach a climax when the living candelabra spring from their pedestals and dance out into the room, grouping themselves into a beautiful and enormous bouquet of light.

In the last act the curtain drops on a wedding feast and apotheosis. All at once there burst out thousands and thousands of tiny glow lamps of all colors outlining flowers, garlands, flags and even the bridal coach itself, and over the whole there spreads a great canopy of 17,000 small incandes-

Fig. 2.—Living Electrical Candelabra.

cent lamps hiding the cupola of the arena. The accompanying illustrations give but a faint idea of the spectacle. The stage elevating mechanism is operated by 14 motors, and can be controlled by a man from a single position.

MUNICIPAL ELECTRICAL INSPECTION IN CHICAGO.

One bureau of the city government in Chicago that has been conducted with efficiency and credit for a number of years is the city electrical inspection bureau of the Department of Electricity. About a year ago the rules and regulations of the city for the installation of wires and apparatus for electrical service were officially incorporated into a city ordinance, and now every rule is an ordinance, and a violation of it is a violation of the law. The standard of wiring and construction set by these rules is notably high, and in some respects the requirements are more rigid than those of the National Electrical Code. The rules are firmly enforced, and as a result the character of electrical construction done in Chicago is at least as good as in any other city in the country. Chicago was probably the first city in the country, for instance, to require the use of conduit for all concealed wiring.

Some time ago a Committee of Twenty of the National Board of Fire Underwriters investigated inspection conditions in the various localities, and it took occasion to compliment the municipal inspection bureau in Chicago on the efficiency of its work. The municipal electrical inspection is accepted unreservedly in Chicago by the fire-insurance underwriters. All new work or repair jobs must pass city inspection before the current is turned on. There are a few underwriters' electrical inspectors, but they confine themselves almost altogether to special inspections made at the request of fire-insurance agents

and to old equipment that has had little or no attention for a number of years.

This city electrical inspection bureau is under the general supervision of Mr. William Carroll, city electrician, but is in immediate charge of Mr. George D. Bayle, chief electrical inspector, although for some time, owing to Mr. Bayle's illness, Mr. V. H. Tousley has been acting chief inspector. There are now 22 inspectors in the department, the city being divided into a number of districts, each in charge of an inspector. More inspectors are needed, for some of the districts are too large for one man to cover easily, and at some seasons of the year the work is congested for lack of sufficient help. During the year 1909 61,883 inspections of electrical work were made and 31,837 permits were issued for electric wiring. During the year the bureau inspected installations embracing 1,261,101 incandescent lamps, 8503 arc lamps and 10,638 electric motors, the latter being rated at 75,683 hp. It is interesting to note that there are 5231 electric signs in Chicago, and that two inspectors give all their time to electric signs, which are reinspected every year. The receipts of the bureau from fees largely exceed the expenditures, the estimated receipts for 1909 being $103,000 and the estimated expenses of the department $42,000 for the same period.

One of the duties of the bureau is the investigation of all fires where there are records of the existence of electric wiring in the building injured or destroyed. This investigation is made with a double purpose—to determine in what manner the electrical installation was at fault, if at fault at all, and also to ascertain the damage to the electrical work with reference to the inspection for the repair job that will probably follow the fire. During the year 1909 1762 fires were investigated. Very few of them were found to be of electrical origin; in fact, less than two per cent of all fires in Chicago are found to be caused by electricity, although the exact number had not been figured up at the time of this writing. The bureau also investigates all electrical accidents and quite recently its duties have been enlarged to embrace the inspection of the 350 moving-picture shows in Chicago. These "nickel theaters" are all inspected about once a month.

Politics does not enter into the conduct of the bureau, many of the inspectors having been connected with it for a long period of years during successive administrations. It is pleasing to record the fact that here is at least one municipal bureau that is performing valuable work with as much care and thoroughness as is exhibited in private business undertakings.

NEW TELEPHONE PATENTS.

COMBINED TELEPHONE AND ALARM SYSTEM.

There have been many suggestions for the combination with the telephone of an alarm system of some sort, and a patent recently issued deals with the latest suggestion along this line. This is the invention of Mr. J. G. Nolen, of Chicago. At the subscriber's station there is connected to the line a signal drop and a branch circuit including the emergency contacts, normally open, and distributed as required. At the central office the ringing generator is normally connected from the ground to one side of the line. The closing of an emergency contact affords a ground path for the generator current through the drop, thereby causing it to fall. Through the night-bell contacts of the drop is carried a circuit which causes a continuous ringing of the bell of the telephone instrument, which will frighten any intruder and wake the occupants of the premises. In addition the calling lamp is caused to glow at the office and the continuous sound of the ringing current notifies the operator that the call is an emergency one.

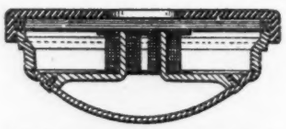
IMPROVED INSTRUMENTS.

Most receivers and transmitters are designed as individual instruments, the respective shapes bearing no particular relations to each other. Mr. A. L. Sohm, of Whittier, Cal., has, however, designed his two instruments to form a combination one, when they are not in use. The transmitter varies from the usual design in having no flaring mouthpiece. Its face carries holding-buttons so designed that when the ear-cap of the receiver is placed against the transmitter, the receiver will be held there. The hand hold of the receiver is, of course, much shortened. The palm of the hand may cover it entirely. The electrical circuits are controlled by a switch, the lever of which deflects to the side when the receiver is returned to place. Mr. Sohm's patent has been assigned to the National Electric Works.

Mr. S. A. Duval, of South Bend, Ind., has patented a transmitter of the solid-back type. In this type of instrument the connection between the diaphragm and the movable electrode usually lies in a small control stud passing through a perforation in the diaphragm and held by nuts screwed down upon it. In this transmitter the stud is enlarged to the size of the front electrode. The diaphragm is correspondingly perforated by a large central hole at the edge of which the diaphragm is reinforced by a ring. The enlarged stud is screwed into the diaphragm aperture.

A multiple transmitter forms the subject of a patent issued to Mr. Frank Wood, of Newport News, Va. The invention comprises a plurality of transmitters in the base of a common funnel-shaped mouthpiece. The small end of the funnel receives the sound. Each transmitter has a distinct circuit connected to a corresponding receiver.

Two patents granted to Mr. Charles E. Williams, of Boston, Mass., refer to instruments used with audiphone sets. One of these is a receiver, such as shown in the accompanying illustration. It will be seen that a part of the casing is of steel and thus serves as the polarizing magnet. A compact instrument is obtained. The second patent deals with the transmitter part



Williams Audiphone Receiver.

and its adjustment. It is found an advantage to adjust the sensitiveness of the transmitter from time to time to suit the condition of the batteries and also the condition of the ear of the user. To accomplish this result a series resistance is included in circuit and means are provided to shunt this out gradually as more sensitiveness is required. The resistors are wound upon a drum and points are brought out, spaced at increasing angles from the normal. A metal comb trails the drum, and as this latter is rotated one after another of the contacts rides under a tooth maintaining a short-circuit of its corresponding section through any further advances of the drum.

LINEMAN'S HAND SET.

A lineman's hand telephone set has been patented by Messrs. H. F. Thoma, Jr., and Clifford McGren, of Chicago, Ill. A fiber strip of channel section connects the receiver and transmitter parts. The latter has a fiber instead of metal casing. Screws are used to mount the transmitter and receiver parts in position and these screws serve as electrical connectors. The wires joining them to each other to complete the circuit lie in the channel, and they are covered by insulating compound laid in to fill the channel.

COMBINED TELEPHONE AND SIGNAL SYSTEM.

Mr. J. G. Nolen, of Chicago, has patented an arrangement of combined burglar alarm and telephone system wherein the operation of one of the emergency contacts throws in a buzzing relay. This relay has its windings in series with its own contact and it serves to set the line signal at the central office and to put its characteristic hum or buzz upon the line so that the operator recognizes the character of the signal.

STEP-BY-STEP APPARATUS.

A step-by-step party-line system has been invented by Mr. C. W. Throckmorton, of Pittsburgh, Pa. The novelty lies in the

method of operating the local selectors. These are spring controlled, and the system includes means for automatically winding them incident to selection.

LETTERS TO THE EDITOR.

The Electrical Contractor in Great Britain.

To the Editor of Electrical World:

SIR:—I read with interest Mr. Glenn Marston's article in your issue of Jan. 13, and I feel that he might have gone a little deeper into the subject. Mr. Seabrooke, whom he mentioned, deserves great credit for the able manner in which he has developed the corporation electricity supply in the West Ham district of London. He was the pioneer in developing the canvassing system for obtaining consumers, and soon branched out into the supply of motors and lighting appliances. On the introduction of metallic filament lamps, a large number of British central station engineers thought their doom had come or was coming because the energy consumption would be reduced. Such was not the case with Mr. Seabrooke who used it as a means of getting new consumers, reduced the price of supply in his district, and employed it as a most effective weapon with which to combat the gas companies. In many ways Mr. Seabrooke is right when he says that the Britisher doesn't want to be bothered with half-a-dozen contractors when about to install the required plant. The trouble is that often the British electrical contractor isn't an electrical engineer and is not properly qualified to give advice. Too often he takes the form of a glorified plumber or gasfitter. Then if through faulty installation—by faulty I mean unwise or badly planned, or where the cost of running is greater than the consumer anticipated—the central station engineer and not the contractor receives the blame. Naturally the central station engineer would rather do the whole business himself. If this scheme is adopted an outcry against municipal trading immediately results, because people do not consider it fair that municipal finance should be used against private firms. The fact that the contractors confine themselves to supplying house installations and fixtures is not only accounted for because it yields most profit, but also because often the contractor has not the knowledge to install electric equipment in a large factory. If the contractors' association would exert itself largely toward the increase of effectiveness of its members, the central station engineers would be less willing to indulge in the contracting business. Many cases can be found in Britain where practically the only motor load obtainable is that of the tramway system, the only other demand being for lighting, because there are practically no factories in the district and hence the load-factor is low. I quite agree with Mr. Marston that there is room for both the contractor and the central station engineer and that they ought to be able to work more harmoniously together.

LONDON, ENGLAND. S. M. HILLS.

Federal Regulation of Wireless.

To the Editor of Electrical World:

SIR:—The matter of Federal legislative control or supervision of wireless telegraphy has to-day reached a state where its advisability, in some form, seems accepted by most of those who are chiefly concerned in the practice or development of this important art. The writer, for one, believes that whether we desire to see it or not, such restrictive legislation is shortly inevitable of enactment. If this legislation be violent, drastic and hastily conceived, great injury will be done to the development of a splendid and useful art. If, on the other hand, this legislation be moderate and enlightened, guided by the best which our decade of experience has taught, then it can suppress many existing evils and aid rather than hinder the development of this science. Such legislation can thus greatly enhance the value of wireless service to the public and to the Government as well.

To enforce properly any legislation which may be enacted, I foresee a permanent commission, whose complexion shall be much the same as that of the one proposed by Representative Roberts—a body whose authority in interpreting and enforcing the enacting legislation shall be final, and subject only to such redress or appeal as our courts of justice in like instances afford.

The preliminary commission called for by Mr. Roberts's resolution should, in my mind, recommend legislation along the following lines:

Within a certain time, say, six months, all wireless stations should be prohibited from operating which have not then obtained governmental licenses. A reasonable license fee should be exacted. Stations should be divided into three classes—governmental, commercial and experimental—whether on ship or ashore.

All ship or coast stations should have apparatus enabling them to use in time of danger a certain common wave length, but ordinarily communications should not be carried on with this common wave length.

It should be obligatory, of course, upon all stations to suspend all business in favor of a prearranged call of danger or distress.

Far more important than the allotting of a certain wave length to each station (which I consider an unnecessary provision) is the need for fixing the *maximum damping* which any transmitting apparatus shall be allowed to have regardless of whether this transmitting station be governmental, commercial or experimental. I suggest that this maximum damping be fixed at 0.04. (This "coefficient of damping" γ is defined as follows: $\gamma = \frac{F}{F'}$ where F and F' represent the amplitudes of two successive waves of the train.)

It is to-day easy to build transmitting apparatus which shall have a considerably less damping than this figure, and if all transmitters have such small damping, and if receiving stations are provided with modern and well-designed tuning appliances (which the requirements of the service will very soon compel all to adopt), then the question of interference between legitimate commercial and Government stations will practically solve itself automatically. This is evidenced beyond any doubt by the work of our own stations using the "Radio Tone" transmitter system.

The present licensing commission should refuse to license any wireless station so located that its antenna wires come within, say, 500 ft. of any other existing operating licensed station.

Class 3 or experimental stations should be very greatly restricted. I recommend limiting them to ownership by organized companies, or operated by independent experts of well-recognized skill and standing, and to university laboratories—in short, to those concerning whose serious purpose the commission should have no doubt. This provision will probably eliminate the nuisance of the irresponsible amateur. These experimental stations should be restricted to the use of wave lengths differing by 10 per cent or more from those of any commercial stations within, say, a 10-mile radius of them.

The commission should be empowered, on receipt of conclusive evidence of wilful interference, after due warnings to the offending station, to revoke the license of said station. The penalty for operating without license might be a fine for each separate offense of operating without license or after revocation of license.

If any station should establish before the commission the existence of troublesome interference from any rival stations using the same wave length as those stations with which it ordinarily does business, then the commission should be empowered to fix certain limits of wave length for such conflicting stations, within which they shall thereafter operate.

You will notice that in the above I have recommended no restriction as to the power which a station may have. I do not think this restriction wise or necessary, provided only that the

damping of the transmitters shall not exceed the stated maximum, and the wave lengths shall, if necessary, be regulated as above set forth.

The Federal commission should have power to settle any disputes or complaints regarding interferences, and in so ruling should give preference, first, to official business from Government stations; second, to commercial business from commercial stations; third, to experimental operation; and, fourth, to social business from Governmental stations.

In any case, however, if the one against whom complaint has been made can prove that he is using transmitting apparatus having a maximum damping not exceeding the authorized limit, and a wave length differing by 10 per cent or more from that which the complaining station seeks to receive, then the fault must lie with the improper construction or operation of the complainant's receiving apparatus, and it is incumbent upon the latter to adopt improved apparatus and up-to-date methods, rather than to expect the commission to restrict the interfering station.

New York. Lee de Forest.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Compounding Alternators.—B. Schaefer.—Various methods for compounding alternators are based on the principle that the alternating current in the line is changed by means of a rotary converter into direct current, which then influences the excitation of the alternator. Instead of a rotary converter the author proposes to use the mercury-vapor rectifier. The arrangement of his tests is shown in Fig. 1, in which *a* is the alternator, *b*

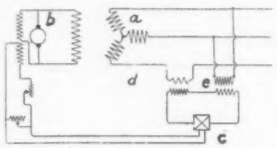


Fig. 1—Diagram of Connections.

the exciter, *c* the mercury-vapor rectifier, *d* a series transformer and *e* a shunt transformer, the latter two being employed to produce the current which is supplied to the mercury-vapor rectifier. The author reports the results obtained with this method with a 50-kva dynamo. The results show that with a non-inductive as well as with a highly inductive load the voltage of the network can be maintained constant by this method.—*Elek. Zeit.*, Jan. 20.

Single-Phase Motor.—A note on a recent British patent of F. Punga (133, 1909; Jan. 6, 1910). In series commutator motors, in which the compensating winding is in series with the auxiliary pole windings and the compensating current is generated by induction, an auxiliary pressure is applied to this circuit from tappings off the main transformer, in order to displace the current in phase and thus completely neutralize the pressures induced in the short-circuited armature coils.—Lond. *Elec. Eng'ing*, Jan. 13.

Induction Motor Construction.—E. L. Farrar.—A description of several tendencies of modern induction motor design. The stator frames afford the best opportunity for the elimination of weight without a sacrifice of rigidity, at the same time providing for the most efficient heat radiation. This idea has been worked out in the riveted-frame construction of smaller sizes and the skeleton frame of larger sizes. The author discusses then the question of straight versus overhung slots in the stator punchings. As to the proper construction of squirrel-cage motors it is said that experience shows that for the smaller sizes a better electrical joint can be obtained by the use of soldered end rings, while for the larger sizes a bolted construction, using spring washers to compensate for unequal expansion of the bars and bolts, is the most suitable. As to the best friction metal to use for induction motor bearing linings, it is said that cast-iron shells lined with hard (or so-called tin) babbitt are the best for all except the smaller motors. For these use is made of an alloy that has the same desirable quality inherent in babbitt, namely, that of not scoring the shaft in case the bearing "freezes" through lack of proper lubrication. All bearing housings should be made dustproof.—*Gen. Elec. Review*, February.

Cooling of Transformers.—R. D. Gifford.—A paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. on the influence of various cooling media upon the rise in temperature of soft-iron stampings of transformers. The object of the research was to determine the conductivity to heat flow existing between the surface of a cylinder made up of soft-iron stampings and such cooling media as air and oil under the following conditions: When the iron was free in air; enclosed in an iron case; in a case, with draught of air flowing over the surface of the iron; with iron surrounded by oil; iron in oil, and with cold water circulating through a cooling worm immersed in the oil. The results are given in tables and diagrams, and are summarized as follows: By far the most effective method of cooling transformers is that of oil cooling, assisted by the circulation of cold water through a coil of pipes immersed in the oil. As the water absorbs a high percentage of the total energy loss, it is unnecessary to provide a case with a large cooling surface. This method should, therefore, be adopted for large transformers, when there is a good supply of cold water available. If this is not available, the same water can be used continuously with the use of an outside cooling arrangement and a circulating pump. If, owing to a temporary breakdown of the pump, the water supply is stopped, no great danger may be apprehended, as the enormous thermal capacity of the oil and the water in the coil prevents any large rise in temperature for a considerable time. On no account should a joint be made in the coils inside the case, as this leads to a liability to leakage, the slightest trace of moisture in the oil reducing its dielectric strength very considerably. With regard to unassisted oil cooling, this is much more effective than any type of air cooling, as the thermal conductivity of iron to oil is so much greater than to air. The cooling by air blast, although effective, necessitates the use of blowers and air filters, and, further, if for any reason the blast be stopped the temperature of the transformer will quickly rise to a dangerous degree. Natural cooling of air is simple and economical, but this method can only be applied to transformers of small size, as the energy loss, for the same induction and frequency, is proportional to the cube of the linear dimensions, whereas the cooling surface is only proportional to the second power, and, therefore, the heat to be dissipated per square centimeter of surface rises rapidly with increase in size, producing thereby a higher temperature rise of the transformer.—Lond. *Electrician*, Jan. 14.

Transformer Drying.—E. L. Gehrkens.—An illustrated description of a portable outfit for drying transformers and the oil to be used in them. It comprises chiefly a hot-air furnace, a positive pressure blower, a dust collector and the driving motor.—*Gen. Elec. Review*, February.

Mutual Induction Between Phases.—J. Rezelman.—In a continuation of his former paper on stray-field reactance, the author describes some experiments which he has made with a new machine with a special arrangement of the outer coils, and shows that these experiments confirm his ideas on the mutual induction between phases.—*La Lumière Elec.*, Jan. 22.

Lamps and Lighting.

Incandescent Lamps.—Fery and Chenevau.—In a continua-

tion of their research recently noticed in the Digest, on the application of the radiation laws to incandescent lamps, the authors give the following numerical data on tests of two carbon and tungsten lamps:

		Carbon.	Tungsten.
$W = aT$	$a =$	2.95×10^{-12}	2.93×10^{-14}
	$x =$	4	4.6
$J = Ae^{\frac{B}{\sqrt{w}}}$	$A =$	2.08×10^{6}	3.08×10^{6}
	$B =$	32.05	27.63
	$x =$	4	4.6
Temperature of filament in normal operation		1,780°C	1,875°C
Resistance in normal operation in ohms		11.78	189.8
Volts		25	110
Amperes		2.12	0.58
Watts		53	63.8
Horizontal cp in normal operation		15.4	52.7
Specific consumption in watts per cp in normal operation		3.44	1.21

The authors think that while they studied only the tungsten lamp, other metallic-filament lamps would behave in an analogous way.—*La Lumière Elec.*, Jan. 22.

Metallic-Filament Lamps.—L. BLOCH.—In the testing department of the Berlin Electricity Works life tests of five metallic-filament lamps taken at random from the stock supplied by Allgem. Elek. Ges., have been made since August, 1908. The lamps were switched in and out four times a day, to imitate as much as possible the conditions of practice. By October, 1909, the test had extended over 10,000 hours. The first of the five lamps failed after 6800 hours, the second after 8700 hours, while the three others were still burning after 10,000 hours. The change of the candle-power and specific consumption during life is given in the following table:

Hours.	Candle-power in per cent of original value.	Watts per hefner cp.
0	100.0	1.22
500	101.5	1.20
1,000	97.5	1.27
2,000	91.5	1.36
3,000	86.0	1.37
4,000	84.0	1.36
5,000	83.0	1.37
6,000	81.5	1.41
8,000	77.0	1.51
10,000	75.0	1.60

These quite favorable results should not be generalized since the quality of the lamps fluctuates to a certain degree. But as the tested lamps were chosen at random from the original stock, the results show the great progress which has been made in the manufacture of metallic-filament lamps.—*A. E. G. Zeit.*, Vol. 12, 1909, page 11; *Elek. Zeit.*, Jan. 20.

Osram Lamps and Tariff Reform in England.—In a lecture by Mr. H. Hirst, of the (Brit.) General Electric Company, on the subject of tariff reform, it was mentioned that osram lamps were originally wholly imported to England from Germany. Later it was decided to erect works for the manufacture of these lamps in Hammersmith. Two or three German firms with which the company has business relations have intimated that they would erect works in England in conjunction with the General Electric Company if tariff reform were introduced. The author concludes that if a tariff was introduced in England many factories would be erected paying good wages to workingmen.—Lond. *Elec. Eng'ing*, Jan. 13.

Generation, Transmission and Distribution.

Electric Drive for Rolling Mills.—A. S. MCALLISTER.—An exposition of the fundamental principles to be considered in the choice of a system of electric driving of rolling mills. With rolling-mill motors of the reversing type, direct-current motors must be used. For the direct driving of non-reversing rolling mills the polyphase induction motor is best adapted. To decrease the size and cost of the generating plant some system of energy storage is advisable, either mechanical (flywheel) or electrochemical (storage battery). When a limited amount of energy is to be used for a short time at a very high rate the flywheel is much less expensive and more satisfactory than the storage battery, but where a considerable amount of energy is to be stored for use at a relatively low rate (represented by cyclic intervals of several seconds) the battery is far preferable to the flywheel.—*Met. and Chem. Eng'ing*, February.

Rail Mill.—B. E. SEMPLE.—An illustrated description of the electric equipment of the rail mill of the Indiana Steel Company, at Gary, which contains the largest induction motors ever built, and is the only rail mill in existence entirely motor operated in which finished rails are rolled directly from the ingot without reheating. Some 30,000 rated horse-power in alternating-current and direct-current motors are required for the operation of the mill, about 25,000 hp being furnished by alternating-current machines and the remainder by direct current.—*Gen. Elec. Rev.*, February.

Lineshaft Drive and Individual-Motor Drive.—A. G. POPCKE.—A discussion of the question of lineshaft drive versus individual-motor drive in machine shops, dealing with the different items which have to be taken into account and giving several numerical examples showing how to figure out the question of economy obtainable. In the examples given by the author, the only consideration favoring lineshaft drive—namely, lower first cost—is much more than overbalanced by the increased production possible with individual-motor drive; also, the cost of energy, though in favor of motor drive, plays a very small part in the determination of operating expenses in a machine shop. The higher the cost of energy the more favorable the proposition becomes to individual-motor drive. The question of whether or not to use individual-motor drive in any particular case is a financial one and must be properly analyzed. Individual drive means an increase in investment, but in nearly all cases a much greater percentage income will be reaped than if lineshaft drive were employed.—*Elec. Jour.*, January.

Electricity in Mines.—C. V. ALLEN.—A long illustrated article describing various electric applications in mining work with special reference to mining methods in Mexico. The author deals with ventilation, pumping, ore handling (haulage, cableways and hoisting), crushers and rolls, stamps, tube mills, and the use of electricity in cyanide plants.—*Elec. Jour.*, January.

Steam Turbine.—P. EHRLICH.—A profusely illustrated article on the different types of steam turbines and turbo-dynamos.—*Elek. und Masch.* (Vienna), Jan. 2 and 9.

Boiler Plant.—M. GENSCH.—The conclusion of his illustrated description of the boiler plant of the electric central station of Buenos Ayres. The principal feature is that the economizer, which is usually only an auxiliary to the boiler plant, represents in this case an essential part of the total heating surface.—*Elek. Zeit.*, Jan. 20.

Most Economical Vacuum.—R. M. NEILSON.—A paper read before the Glasgow Section of the (Brit.) Inst. Elec. Eng. on the most economical vacuum for power stations employing steam turbines and cooling towers. The items appreciably affected by the vacuum are, as regards the initial cost of the station, boilers and condensers; while the annual charges affected are the coal bill and interest, depreciation, maintenance, etc. The author gives curves showing the relation between these items and the vacuum, and explains how the most economical vacuum can be ascertained for each load factor.—Lond. *Electrician*, Jan. 14.

Niagara Falls.—C. W. JORDAN.—A paper read before the (Brit.) Inst. Mech. Eng. describing the generating plant of the Ontario Power Company at Niagara Falls.—Lond. *Elec. Eng'ing*, Jan. 13.

Traction.

British Tramway Statisttcs.—The annual statistical tables on electric traction undertakings in the United Kingdom. There are three tables. The first of these deals with electric tramways obtaining a supply of energy from a "combined" lighting and traction power station; the second with electric tramways obtaining their energy from an independent station (supplying energy for traction purposes only); and the third refers to electric railways. Only two new stations appear in the present tables compared with last year. The total length of electrically equipped tramway track has only increased during the last 12 months from about 3840 miles to about 3960 miles, or about 3 per cent. This increase, which is, of course, largely accounted for by extensions to existing lines, is disappointing, being much less than 5¼ per cent growth recorded last year, and that of 9 per cent two years ago. The trolley omnibus is probably

proving a disturbing factor, since the lower capital expediture possible with any scheme of railless traction is an important factor in the success of extensions to existing undertakings, or of new undertakings which are likely to be considered in the future. These lines will in most cases be constructed in less densely populated districts than those at present served by electric tramways. From the Leicester Municipal Tramways 640 hp of private motors are supplied with energy from the trolley wires. There is a great divergence in the price charged for energy for tramway purposes. The price varies from 1.5 cents to as high as 5.5 cents per kw-hour. Where both the electricity and tramway undertakings are owned by a municipality, a very satisfactory arrangement is that adopted at Belfast, where the station is run conjointly by the two departments, while in the case of Cardiff the customary position is reversed, and the tramway department sells energy to the electricity department.—Lond. *Electrician*, Jan. 14.

Installations, Systems and Appliances.

Flat Rate with Load-Limiting Devices.—Norberg Schulz.—The electric station of Christiania, in Norway, has introduced since the summer of 1905 a new flat rate for private consumers, charging $56.25 per kilowatt used at the same time and per year. Originally maximum-demand indicators of the Wright type were employed for control. In 1906, however, simple devices for limiting the load were introduced, and the results were so good that while 99 were installed in 1907, the number of those installed in September, 1909, had risen to 932. At present from 40 to 74 such devices are being installed each week. A rent of 84 cents is charged per year. The consumer is permitted to install an electricity meter and to switch the whole load over to the meter when he wants to exceed the limits of the load. Every kw-hour used in this way costs 8.4 cents and a rent of $1.70 is charged per year for the meter. Of the 932 consumers who have devices for limiting the load, 275 have also electricity meters, and all of them are large consumers. In the 501 private residences in which only load-limiting devices are used without meters, incandescent lamps, etc., representing a total of 417.85 kw are installed. But the load of these 500 residences is limited by the limiting devices to a total of 172.93 kw, or 41 per cent of the rating of the connections. The introduction of this cheap rate has resulted in many new connections. As to the question whether the central station can make a profit with such a rate, the following figures are given: The generating cost of the station per kw-year in 1908 was $20.75 for the water-power station and $16.25 for the steam plant, including fuel. The average is $18.50, including interest at 4 per cent, and amortization at 4 per cent. The expenses for distribution of the energy are about $15.75 per year per kilowatt of maximum load, so that the total yearly cost is about $42.50 per kilowatt of maximum load. Very small consumers bring hardly any profit to the station since with their increasing number the expenses of the station increase too rapidly. To overcome this difficulty the plant is now making the experiment of supplying energy in bulk to tenement houses. One case is a tenement house consisting of three joint buildings having a total of 141 flats for workingmen, each consisting of two or three rooms. A total of 300 metallic-filament lamps were installed. The energy is charged for according to the flat rate mentioned above and is paid in bulk by the proprietor of the house. Each of the three houses has a load-limiting device, and the proprietor rents the flats including light. The tenants have to pay for the renewals of the lamps themselves. One-third of the wiring costs have been paid by the station. This arrangement is intended as an experiment only.—*Elek. Zeit.*, Jan. 20.

Combined Lighting and Motor-Service Meter.—A note on a new meter placed on the market by a British company for the purpose of encouraging the use of electric heating and cooking appliances. The equipment comprises a standard lighting meter with an additional terminal, which is connected inside the meter to the main current coils. The connection is made in such a manner that the energy taken by the heating, cooking or other appliance does not pass through all of the turns of the main series coils, but only through a portion of them, dependent on the ratio of the motor-service charge to the lighting charge. The energy taken by the lamps in the installation passes through the meter coils in the ordinary way. The meter thus registers the units consumed for lighting, and, in addition, that proportion of the motor-service consumption which, charged for at the lighting rate, equals the total consumption charged for at the motor-service rate. To deduce the total bill

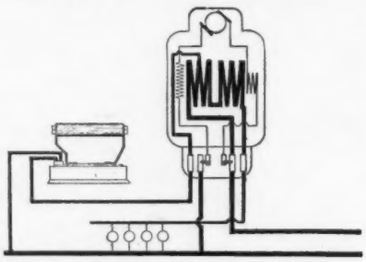
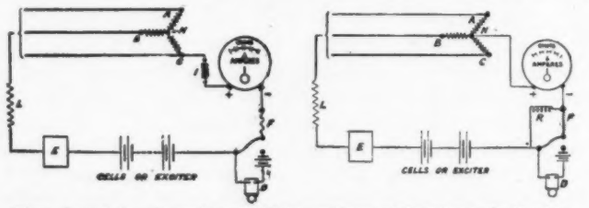


Fig. 2.—Combined Lighting and Power Meter.

for lighting and motor service, the total units registered by the meter must, therefore, be multiplied by the lighting rate. The method of connection for a direct-current meter is illustrated in Fig. 2, in which the special motor-service terminal is shown connected to one-half of the series windings. In this case the ratio of the motor-service and the lighting rates is assumed to be 1:2; that is, 6 cents for motor service and 12 cents for lighting; it will also be seen that it is only necessary to run one extra main back to the meter from the heating apparatus, etc., and to connect it to the motor-service terminal. Should the motor-service rate be only one-third of the lighting rate, the motor-service terminal is joined to a tapping on the main current coil, so that only one-third of the total number of turns is in series with the motor-service circuit. Both alternating-current and direct-current meters of this type are made, for any ratio of lighting and motor-service rates, and at a price only slightly in excess of those for ordinary meters.—Lond. *Elec. Eng'ing*, Jan. 13.

Leakage Indicator.—An illustrated description of a method for indicating the occurrence of a fault on alternating-current mains in order to meet the requirements of the British regulations of the use of electricity in mines. For continuous-current, two-wire and three-wire insulated systems the earthed voltmeter arrangement forms the simplest and most accurate form of leakage indicator, but for alternating-current circuits this system is inadmissible owing to the disturbing effects of capacity current. For alternating-current circuits the best method of measuring the insulation resistance is to superimpose a small direct current on the system. Fig. 3 shows the arrangement for insulated systems; the source of direct current may be either a primary battery or the exciter of the alternator. In series with the indicating instrument is inserted an inductive resistor. The resistor, though it has a comparatively low resistance, offers a very high impedance to the



Figs. 3 and 4.—Circuits and Connections of Leakage Indicator.

alternating current, preventing the flow of more than 2 milliamp or 3 milli-amp even if subjected to the full line voltage. The indicating instrument consists of a moving-coil ammeter which is unaffected by alternating currents in cases where the frequency is exceptionally low. This instrument is oil-damped to prevent any oscillation of the pointer that might otherwise take place. It is scaled to read directly in ohms and amperes. The top reading of the ampere scale is equal to one-thousandth

of the maximum current of the system, this being the maximum allowable leakage as fixed by the British Home Office rules. The actual leakage current will never be greater than that indicated by the ammeter, but under certain circumstances may be less. If the insulation resistance of the system falls below the allowable limit the fuse attached to the spring contact blows, thereby closing a local bell circuit, which at once gives the alarm. Fig. 4 shows the connections for the system in which the neutral is earthed; here the ammeter is connected in the earth circuit. This arrangement, however, in no way impairs the earthing of the neutral as the resistance of the instrument and battery is only a few ohms. In the event of the fuse blowing out, a resistance R is thrown into circuit, thus preventing the neutral from being entirely disconnected from earth, and at the same time making it impossible for any very large current to flow through the instrument, which might otherwise be damaged.—Lond. *Electrician,* Jan. 14.

Austrian Central Station.—K. THIEN.—An illustrated description of a new municipal central station in Murzzuschlag. It is a water-power plant with a steam reserve. There are two turbines, each of 250 hp, and each driving a 180-kva, 5000-volt, three-phase generator. A third generator of 250 kva is driven by a steam engine.—*Elek. und Masch.* (Vienna), Jan. 2.

Concrete and Cement in Central Stations.—H. N. MULLER.—An illustrated description of some applications of concrete and cement to central-station systems. The author describes reinforced switchboard structures; reinforced-cement shelves in manholes; cement cable armor; fireproof enclosures and reinforcing poles.—*Elec. Jour.,* January.

Machine Tools.—A. COMET.—The conclusion of his very long and profusely illustrated article on electrically driven machine tools, with special reference to French practice.—*La Lumière Elec.,* Jan. 22.

Wires, Wiring and Conduits.

High-Tension Insulators.—K. KUHLMANN.—The first part of a fully illustrated article describing the different types of high-tension insulators.—*Elek. Zeit.,* Jan. 20.

Electrophysics and Magnetism.

Electrical Theory.—E. E. FOURNIER D'ALBE.—The conclusion of his summary of new developments of electrical theory during the last five years. The author discusses electrodynamics, electromagnetic mass, speed of light, identity of mass and energy, new emission theories, and Kaufmann's experiment. A useful list of references to recent literature is added.—Lond. *Electrician,* Jan. 14.

Analysis of Wave-Forms.—H. HERMANN.—An article on distorted voltage and current waves and their analysis. The author shows that for the typical wave-forms found in alternating-current practice it is possible to give simple formulas by the use of which the analysis of such curves is considerably simplified. The article is to be concluded.—*Elek. Zeit.,* Jan. 20.

Electrochemistry and Batteries.

Fixation of Atmospheric Nitrogen.—F. HABER AND A. KOENIG.—A review of the present status of fixation of atmospheric nitrogen. The following table sums up the results obtained with the three successful processes in commercial operation: the process of the Badische company (Dr. Schönherr), the process of Birkeland and Eyde, and the process of Salpetersäure-Industrie Company (Pauling):

	Grams of HNO_3 per kw hour.	Concentration in per cent of NO.
Badische Company	75	2.5
Birkeland and Eyde	70	2.0
Pauling	60	1 to 1.5

The table gives both the yield in grams of HNO_3 per kw-hour and the concentration in per cent of NO, since both items are of fundamental commercial importance.—*Zeit. f. Elektrochemie,* January; abstracted in *Met. and Chem. Eng'ing,* February.

Pulsating Current for Electrolytic Refining.—The Wohlwill gold-refining process was formerly restricted to gold containing a relatively small amount of silver. The reason is that when gold rich in silver is refined by direct current in a solution of gold chloride containing pure hydrochloric acid it becomes necessary to remove mechanically from time to time the layer of silver chloride which forms on the anode, as otherwise chlorine would be set free at the anode. By using a pulsating current, however, instead of a direct current, the layer of silver chloride is broken up and automatically removed into the slime. In this way the scope of the Wohlwill process has been greatly extended. Several other advantages are also pointed out.—*Met. and Chem. Eng'ing,* February.

Zinc Amalgam.—E. COHEN AND W. TOMBROCK.—An account of an experimental investigation of the e.m.f. of zinc amalgam. It appears that in the cases where a potential difference between zinc and zinc amalgam does exist, this is always of such a nature that the zinc forms the negative pole.—Lond. *Electrician,* Jan. 14.

Units, Measurements and Instruments.

Commercial Testing.—E. F. COLLINS.—A continuation of his long illustrated serial on commercial electrical testing. In the present installment the author deals with the following subjects: Regulation tests, speed, voltage; input-output tests; phase characteristics; synchronous and static impedance; wave-form; potential curve between brushes. In taking up the discussion of direct-current generator tests, the author gives some notes on preliminary tests and then describes the standard efficiency test based on calculation of the different losses.—*Gen. Elec. Review,* February.

Electromagnet.—H. E. J. G. DUBOIS.—With the author's so-called semi-circular magnet, designed in 1898, it was possible to obtain within an air-gap 1 mm in length and 6 mm in diameter a field intensity of from 38 kilogauss to 40 kilogauss. He has now redesigned this magnet with a view to practical use. By reducing the gap, he could attempt to increase the field up to 50 kilogauss without exceeding a total weight of about 300 kg distributed over three equally heavy pieces, the apparatus remaining sufficiently easy to handle and carry about in laboratories. Details of the design are described and illustrated.—Lond. *Electrician,* Jan. 7.

Speed Regulator for Motors.—E. GIEBE.—A full description of a sensitive speed regulator for electric motors, used for precision measurements at the Reichsanstalt. As has already been described in the Digest, this is a centrifugal regulator in which the centrifugal force of a revolving mass is balanced by the elasticity of a spring. By the closing and opening of a contact resistances are short-circuited or inserted. In the present article the construction of the apparatus is described in detail and its theory is given.—Lond. *Electrician,* Jan. 7.

Single-Phase Meter.—A communication by the Reichsanstalt on the admission for calibration of recently improved single-phase induction meters and three-phase meters for balanced systems of the Allg. Elek. Ges. The improvements over former construction are described.—*Elek. Zeit.,* Jan. 13.

Calculation of Coils.—E. H. WEISS.—The author discusses mathematically the following problem: For a coil of given physical constants, what diameter of the wire must be chosen in order to obtain a certain resistance, especially if the wire is heavily insulated?—*La Lumière Elec.,* Jan. 8.

Telegraphy, Telephony and Signals.

Loaded Telephone Lines.—An account of the extended discussion which followed the paper by Ebeling, recently abstracted in the Digest, on the use of Pupin coils for loaded telephone lines in German practice. Breisig and Becker participated in the discussion with special reference to the agreement between theory and practice.—*Elek. Zeit.,* Jan. 20.

High-Frequency Generator for Wireless Telegraphy.—L. H. WALTER.—A description of Peukert's high-frequency generator for wireless telegraphy operating on the quenched-spark method, and an account of an investigation of this generator by A. Wasmus. The generator is shown in Fig. 5. A is a fixed iron disk which is capable of axial adjustment; the disk and support are insulated from the bedplate. B is a similar disk, mounted so as to be capable of rotating, axial displacement being prevented by the conical bearing C. Contact with the bed-

plate is secured by means of a brush bearing on the slip-ring *D*. The distance between the faces of the discs is adjusted by means of an epicyclic gear *E*. Oil fed in through the funnel *F* distributes itself equally, during the rotation, over the surface of the disks, covering these with a capillary layer without filling up the interspace. With the disks at rest and separated by about 1/10 mm., on applying a gradually increasing voltage from direct-current mains, a discharge sets in at 250 volts in the form of minute sparks. On reducing the resistance in circuit, the voltage being kept constant, a continuous change of resistance does not always produce a continuous change in the current and potential difference at the disks. Large changes of resistance are at first followed by small changes in the current, until at a certain point the potential difference falls off to a fraction of a volt. At the same time the mechanism of the discharge changes. In place of numerous spark bridges, the current passes at a single spot in the form of an arc. When the current is increased, or when a certain current is left on a little time, the arc disappears without the current path being broken. The conduction in such a case has all the characteristics of metallic conduction. The static characteristic of the process shows that the potential difference between the disks falls sharply at first from about 0.4 volt with 0.25 amp down to 0.25 volt at 0.5 amp, and then more slowly to a minimum of 0.16 volt at 5 amp, above which it rises equally slowly to 0.2 volt at 7 amp. This behavior is the same whether the disks are dry or covered with oil, but the effect is more regular in the latter case. The resemblance in behavior to that of the arc is also maintained when the disks are joined to an oscillatory shunt circuit, but only within certain limits. Undamped oscillations can be obtained only when the applied direct current is greater than 5 amp; the energy obtained is, however, very small. If, however, the primary circuit *I* (see Fig. 6) is coupled, by Wien's method, with a tuned circuit *II*, the latter is excited by "impact," and investigation shows that as regards frequency and damping, the secondary oscillation is entirely independent of the primary and is determined only by the constants of its own circuit. The change of efficiency in changing conditions is discussed, and the advantages of this generator for wireless telegraphy are pointed out.—*Lond. Electrician*, Jan. 14.

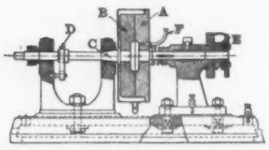


Fig. 5—Cross Section of Generator.

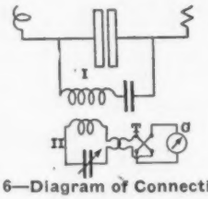


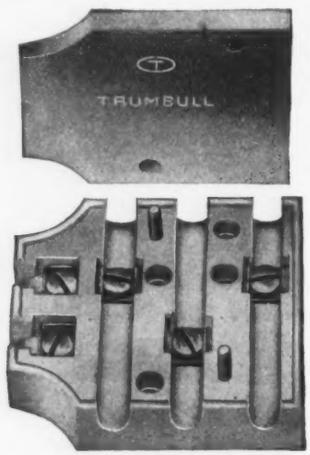
Fig. 6—Diagram of Connections.

Wireless Telegraphy.—An illustrated description of the Arton system of wireless telegraphy in a certain direction. The system is based on the superposition of two electrical oscillations in such a way as to produce asymmetric electromagnetic waves. —*Elek. Zeit.*, Jan. 20.

New Apparatus and Appliances

MOULDING BRANCH BLOCK.

The Trumbull Electric Manufacturing Company, of Plainville, Conn., has brought out a moulding branch block which is a modification of the H. & M. block listed in the Approved Electrical Fittings, the manufacture of which has been taken up by the Trumbull Company. By its use branch connections are easily and quickly made without the necessity of soldering and taping the connections and bringing them up over the mains. The block is inserted in the line wherever a branch is required, and conforming in general dimensions to the standard sizes of wooden moulding, unsightliness is avoided. The branch is taken from the side as indicated in the accompanying engraving, and when the block is covered there is no evidence of the joint. When examination of the connections is desired it is only necessary to remove the cover. Needless to state by the use of this type of device wiring with wooden moulding is greatly facilitated and the appearance of the finished job is comparable with a job in conduit.



Moulding Branch Block.

NEW LIGHTING FIXTURE.

A complete line of lighting fixtures, known as "mazdaliers," has recently been placed on the market by the Western Electric Company. These fixtures are designed in two styles, a stem type and a close ceiling type. The stem type, as shown herewith, is intended for all classes of service where ceilings are 10 ft. high or over. The close ceiling type is intended for ceilings less than 10 ft. and where clusters are preferred rather than one-light units.

Fig. 1.—New Lighting Fixture.

A special feature in the construction of the mazdalier, which adds to the life of the lamps, is the method of suspending the lamp socket. The life of the mazda filament depends largely upon the conditions under which it is operated and the method of support. If properly supported and protected from jars

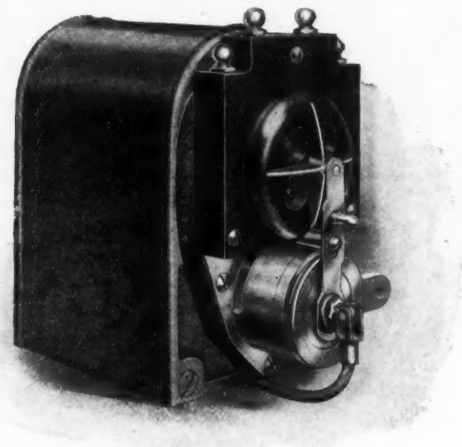
and vibrations the life of the lamp is greatly increased. It will be noted that the suspension of the lamp in the mazdalier is made through a series of links, so that any vibration which is transmitted to the fixture is broken before it reaches the lamp.

The fixtures are adapted to practical illumination and furnished in standard finishes of brush brass and nickel. The standard arrangement of fixtures is for one, two, three, four or five lamps, provided with Holophane reflectors. The standard spread of two-lamp and three-lamp fixtures is 15 in.; four-lamp, 20 in., and five-lamp, 25 in. The stems are based on a length of 25 in. over-all from top of stem to bottom of reflector. Various spreads and various hanging lengths can, however, be used. The system of lengthening is so designed that the fixtures can be used with any height of ceiling.

Fig. 2.—New Lighting Fixture.

MAGNETO IGNITION GENERATOR.

The high-tension magneto generator herewith illustrated attracted considerable attention in New York at both the Grand Central Palace and Madison Square Garden shows. The magneto is built along conventional lines, but is said to have many improvements. This magneto will produce a good-sized spark at the slowest possible engine speed; in fact, the manufacturers claim that the engine can be stated on one-quarter turn of the starting crank. Spinning is not necessary. This point is of much importance for it means that an automobile can be driven through crowded streets and around corners at slow speed, making it unnecessary to change gears or switch over to the batteries.



Magneto Ignition Generator.

The magneto has all the advantages of the double-wound armature type of magneto and the low-tension type with separate coil on the dash. The transformer coil screws into the bow of the magnets in cartridge form so that in case of a burn-out or break-down immediate repairs can be made by simply inserting a new coil as though substituting a new unit in a spare coil. The magneto is fully enclosed, and hence it is water and dust proof; it can also be changed from right to left running by simply changing three screws.

The construction has been greatly simplified by reducing the number of parts. These parts can be changed in the dark, as there is only one way for them to fit and they cannot go together incorrectly. This magneto cannot be short-circuited by too much oil, as there is a special drain which carries off all excess oil. A unique feature is that four safety-gap windows are used, and in case one of the cylinders is missing, the spark will immediately begin to jump across one of the windows, so that the operator can note at a glance in which cylinder there is trouble. The magneto is fitted with ball bearings throughout. It has been placed on the market by the United Manufacturers, of New York, as sales representatives of the Connecticut Telephone & Electric Company, Meriden, Conn.

NOTABLE METALLIC-FILAMENT LAMP INSTALLATION.

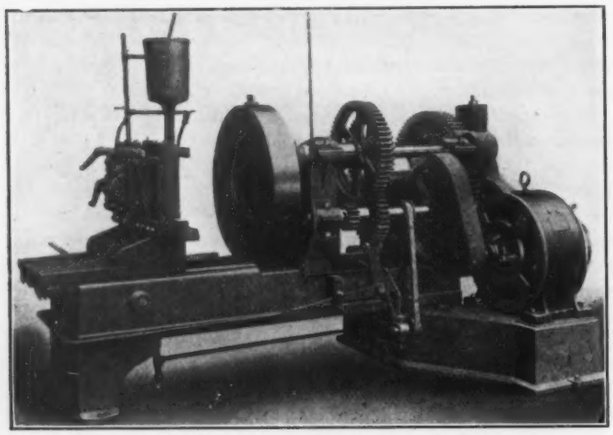
The largest individual installation of Mazda lamps in Indianapolis is the new store of D. Sommers Company, where 5070 Buckeye lamps of the latest type have been installed. Of this number 3700 are 40-watt and 60-watt lamps and 1370 are sign lamps. The illuminating effect is remarkably brilliant, the wattage being easily double what would ordinarily be used in order that the name "The Daylight Store" might be sustained after dark. A roof sign, 80 ft. long and 40 ft. high, contains the firm name and a clock outlined in lamps. Twenty-one 8-ft. letters are used in the sign, which requires 1370 Mazda lamps and five compensating transformers. The installation is on the circuits of the Merchants' Light & Heat Company, making it an excellent advertisement for the lighting company.

Metallic-Filament Lamp Installation.

MOTOR-DRIVEN PIPE-THREADER.

The accompanying illustration shows an adjustable-speed, direct-current motor driving a machine for cutting and threading pipe sizes from 2½ in. to 8 in. in diameter, built by the Cox & Sons Company, Philadelphia. Machines of this class are designed in sizes to handle pipes up to 18 in. internal diameter, and for this purpose the special motor-drive supplied has proven especially satisfactory. Where quick changes in speed may be required, as in small shops handling a number of dif-

ferent sizes of pipes, such changes can be most easily made with the adjustable-speed drive, saving the time lost in shifting gears or belts, and bringing the machine promptly to its most



Pipe-Threader.

efficient cutting rate. As seen from the illustration, the pipe threader is provided with one set of gear changes, and has a lubricating system which keeps the cutting tool well flooded with oil. The adjustable-speed, direct-current motor used with this equipment gives a speed ratio of 1 to 4. This motor was built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

AUTOMATIC CONTROL OF MOTOR-DRIVEN PUMPS

In this age of electricity when power and lighting lines span the country in every direction, much of the drudgery of home life is disappearing as the electric motor becomes an indispensable part of the household equipment.

An example of the utility of the electric motor equipped with automatic control, is its application to the operation of pumps required to maintain a certain water level in a tank. By this means, when the level falls below a certain point, the controlling device automatically starts the motor and the pump continues to operate until the water level is raised to a predetermined height, when it ceases to operate.

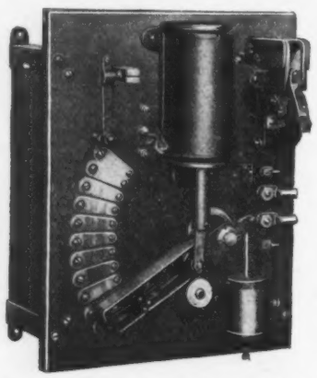


Fig. 1.—Self-Starting Controller.

Figs. 1 and 2 illustrate a device for the service described above, while Fig. 3 shows the manner of its operation. The length of the chain attached to the ball of the float-switch is so adjusted that when the water level falls below a certain point the arm of the float-switch is raised sufficiently to close the motor circuit and start the pump. This continues to operate until the ball rises and allows the weight to carry the arm of the float-switch down far enough to open this switch and disconnect the motor from the line. From Fig. 3 it is seen that the length of the chain and the position of the button may be adjusted so as to make the water levels at which the motor starts and stops any height desired.

Except in smaller sizes, the motor circuit is opened by an auxiliary switch provided with a strong magnetic blow-out device.

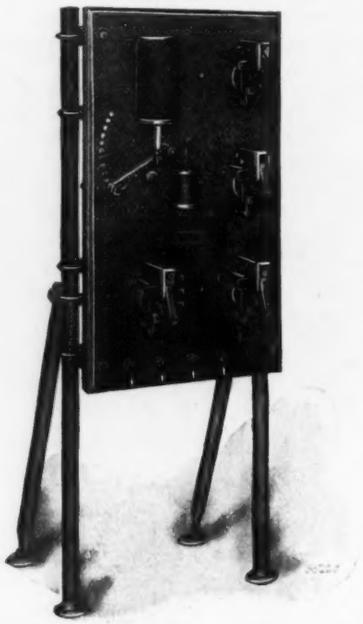


Fig. 2.—Self-Starting Controller for Large Direct-Current Motors.

The motor-starting device illustrated, which can be arranged to maintain any desired fluid or air pressure if supplied with a pressure governor instead of a float-switch, are built by the General Electric Company, Schenectady, N. Y.

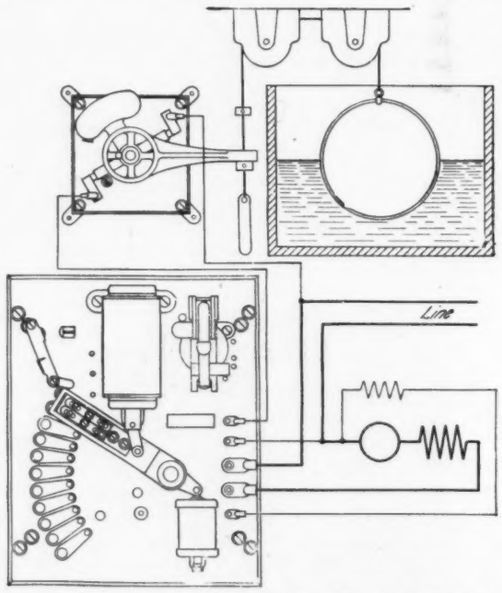


Fig. 3.—Connections of Controller with Float Switch.

CONTROLLER FOR MOTOR-DRIVEN VALVES.

The certain and quick control of the amount of water to be admitted to turbines or impulse wheels driving generators, under all conditions of operation, presents a problem which is best solved by the use of motor-driven valves provided with remotely controlled devices. Such apparatus must be of rugged and substantial construction, as it is subjected to very severe

service. The motor is required to start quickly under full load, and thus must take a large starting current. It must also stop instantly. The controllers shown herewith have been designed for this service. They consist of three separate parts: starting panel, control panel and limit switch. The control panel only is placed at the point from which the valve is to be controlled.

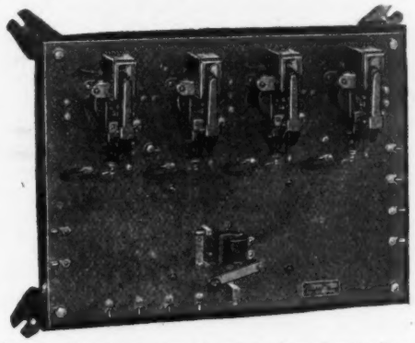


Fig. 1.—Starting Panel of Valve Controller.

The starting panel can be placed anywhere, while the limit switch is connected directly to the valve stem.

The general appearance of the panel is shown in Fig. 1. The circuit is made and broken by contactors, the magnetic blow-out feature of which enables them to open the circuit without appreciable arcing. Two of the contactors close the motor circuit for one direction of rotation and the other two for the reverse direction.

As the majority of the motors operating valves are of the series or compound-wound direct-current type, those rated up to and including 5 hp may be connected directly to the line without the interposition of a starting resistance. The panel illustrated in Figs. 1, 2 and 3 is for this service. The controllers, designed for medium-sized motors, have additional contactors which cut resistance into or out of the armature circuit. For large motors requiring at least seven steps of starting resistance the panel is mounted upon pipe supports and the extra contactors are replaced by a solenoid-operated switch.

The controllers are equipped with resistor units which are non-fragile, fire and moisture-proof and thoroughly ventilated.

The control panel, shown in Fig. 2, contains two pilot lamps for indicating the position of the valve gates, and two relays for closing the circuit of the coils which close the contactors. The relays are so interconnected that should one be closed and an attempt made to close the other, the one previously closed would open, thereby preventing any possibility of a short-circuit resulting from this action and making the device "fool proof."

The arm of the limit switch is moved over the contacts by a rod attached to the valve stem. The length of the rod is so adjusted that when the valve is completely opened or closed the limit switch is at either the upper or lower end of its travel,

Fig. 2.—Controlling Panel of Valve Controller.

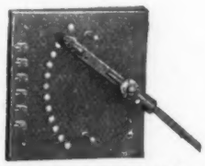


Fig. 3.—Limit Switch of Valve Controller.

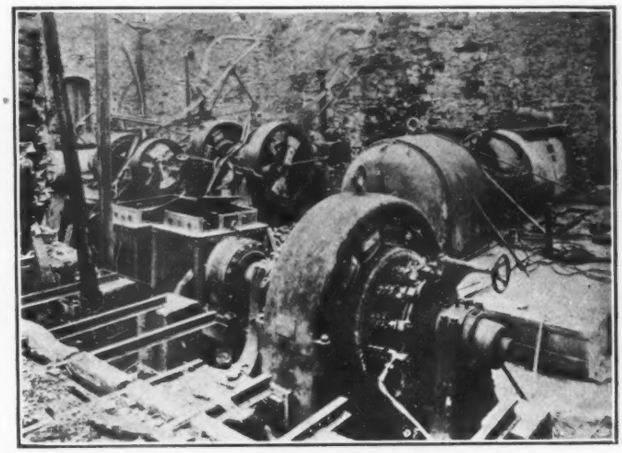
where it short-circuits the coils which close the contactors, thus allowing the latter to open.

The valve is opened by pushing up the core of the relay marked "to open" on the control panel thereby closing the circuit through two of the contactors on the starting panel and applying half voltage to the pilot lamp, thus causing it to show dimly, in this manner indicating to the operator that the valve is being opened. When the limit switch opens the line contactors it also applies full voltage to the pilot lamp, which then continues to burn at full brilliancy as long as the valve remains open. The pilot lamps indicate the position of the valves at all times. These controllers have been placed on the market by the General Electric Company, Schenectady, N. Y.

EXPERIENCE WITH TURBO-GENERATORS IN FIRE.

In an extraordinarily severe test from intense heat exposure occurring during a recent fire at the Trinidad plant of the Southern Colorado Power & Railway Company, two steam turbines came through in remarkably good condition, while two simple, reciprocating engines and all electrical equipment were damaged beyond repair. Some idea of the intensity of the heat can be had from the accompanying illustration, taken after the fire. Although the power house had rough stone walls, the roof and floor were of wooden structure, with light steel trusses for the roof supports and old T-rails for the floors. The pine floors were oil-soaked, causing rapid spreading of the fire and adding greatly to the heat generated. The fire originated in the failure of some second-hand electrical equipments under heavy load, and the burn-out ignited the inflammable material surrounding the apparatus. In three minutes after the fire started it was impossible to get inside the engine-room.

Just at the time the fire was observed the load was being transferred from a 500-kw to the 1000-kw unit, and the auto-



View of Turbo-Generator Units After Fire.

matic safety stops were tripped immediately after the floor took fire. Very likely these machines were spinning during the greater part of the fire, but no effect of rubbing was reported due to the cylinder warping from the unequal heat exposure.

As was to be expected, some exterior parts of both machines were damaged. The cylinder lagging was badly warped and the governor valve gearing, valve piston rings and all springs on both machines were ruined beyond repair. The relay plungers were fused to the bushing, and the brass railings on the top platforms were partly melted.

Although the generator frames were discolored from the heat, the loss sustained was, indeed, very small. The brush-holders were practically destroyed, and the insulation was burned off one of the leads on the 1000-kw unit, but no other damage was done.

Only a short time was required for repairing the units and placing them in service—10 days for the 500-kw unit and 12 days for the 1000-kw unit. The 500-kw unit had been in operation 18 months, night and day, without any repair cost. Repair parts to the extent of $11 were carried in stock and lost in the fire.

In all, the actual cost of repairing both units was about $2,000, including painting—approximately 5 per cent of the initial cost.

A Westinghouse Leblanc condenser, connected to the 1000-kw unit, was not affected, except for damage to the gaskets on the small piping and the pump motor. On a surface condenser, attached to the 500-kw machine, the shell was cracked at the middle, the opening extending practically around the periphery.

The turbo-generator units were supplied by the Westinghouse Machine Company, East Pittsburgh, Pa.

CHICAGO AUTOMOBILE SHOW.

The ninth annual Automobile Show at Chicago, which opened in the Coliseum and the First Regiment Armory, Saturday afternoon, Feb. 5, and will continue throughout the present week, holds perhaps more of electrical interest in the way of vehicles and accessories than have marked any of its predecessors among the Western exhibitions. For the Automobile Show the elaborate streamer lighting effects of the Electrical Show, which preceded it in the Coliseum, have given way to a simple and severely practical illumination which lights the clever reproduction of an outdoor park scene. Low brick walls topped by high iron grillings separate the various exhibition booths and enclose a dozen large trees—real forest specimens, though made temporarily verdant with paper leaves. These merge almost imperceptibly into the painted foliage of the wall decorations, while on the floor below fountains, flowering plants, ornamental brick gate posts and vine-clad trellises have been tastefully disposed to heighten the scenic effect of a well-kept park. Overhead a cloud-flecked sky of painted blue bunting covers the roof trusses of the building. Rows of flaming-arc and carbon-arc lamps furnish the hall illumination, while the individual booths are well lighted by incandescents. A similar, though less elaborate, plan of decoration has been carried out in the Coliseum Annex and the First Regiment Armory.

Improvements in power plant and transmission apparatus and the uttermost refinement of decoration and finish mark the newer and finer cars here exhibited by the leading manufacturers of electric automobiles. The radius of operation of this class of vehicles has been extended, and at the 1910 show the roadster type of electric automobile is more in evidence than ever before. However, the lines along which these machines have been modeled practically show the designers' admission that the gasoline car yet remains the ideal vehicle for country runs, and some of the exhibitors of electric roadsters are still slow to make extravagant claims for long-range operation of their cars at the higher speeds, where the draft on the battery is heavy. The storage-battery automobile is more firmly intrenched than ever in its pre-eminent position as a conveyance for the business man, and for the woman who drives her own car. "A pair of legs for its owner" is the appellation one manufacturer aptly bestows upon his product. The artistic treatment given the design and finish of some of the electric automobiles exhibited at the Chicago show leave little indeed to be desired in either elegance or completeness. Structural improvements, such as stronger and lighter axles, simpler transmission methods, lighter batteries per unit of output, positive-control mechanism, higher motor voltages, and more compact motor construction are some of the important 1910 offerings of the makers.

Among the electrical accessories of the gasoline class of machines, the majority of the ignition devices exhibited are of the jump-spark type, supplied either directly from high-tension magnetos or through transforming coils from primary or secondary batteries, or magneto-generators of lower voltages. For such sparking service a strong tendency seems to be setting in favoring the magneto. An interesting aspect of the gasoline-car situation is the popularity and apparent success of the use of small tungsten and other incandescent lamps, supplied from storage cells, for the auxiliary and tail lights, and even for the searchlights of these machines. Adapter sockets are offered for converting any ordinary oil or acetylene burner into an electric lamp. Some of these adapter receptacles are fitted with an adjustment for accurately focusing the lamp within the reflector and are spring-mounted to avoid transmitting the jars of the road to the filament; although other tungsten-lamp exhibitors assert that their product will negotiate any such vibrations, when mounted merely in rigid clamping sockets, without the relief springs. A system of supply for the car lamps is also offered, using a storage battery, but having, in addition, a magneto generator and automatic regulator device for replenishing the energy of the cells while the car is being run. This equipment can be applied to any machine, it is said.

In the electric vehicle section a prominent feature of the exhibit of the Babcock Electric Carriage Company is its seven-seated limousine town car, a large machine resembling in general the gasoline cars for similar service. This conveyance weighs 2780 lb. and is equipped with a motor capable of developing 16 hp from a battery of 42 storage cells. Other handsome examples of Babcock automobile construction are shown. The Baker Motor Vehicle Company has answered a number of inquiries about a shaft-driven machine in its exhibit equipped with an A-4 Edison battery, and finished in black patent leather, and black and vermillion chassis and running gear. The Columbia Motor Car Company exhibits one of its new landaulet town cars, a luxuriously upholstered electric vehicle with a closed top adapted to be let down. This car departs from the customary Columbia construction in making use of a double-chain drive. The Rauch & Lang Carriage Company shows, among a number of other beautiful machines, an example of its latest 40-cell, four-passenger extension coupé. The greatest economy of space is secured in the differential-compound motor which drives this car by winding its series-field coil and armature with rectangular-section copper, while enameled wire is used in the shunt-field coil. The motor is provided with an extra large commutator for reducing the current density at the brushes. The controller, which is of the face-plate type, is mounted under the seat and is completely enclosed in an aluminum case. It is arranged for electric braking. The 40 cells are connected in series at all times during charge and discharge. The Studebaker Brothers Manufacturing Company showed a handsome electric phaeton and brougham of styles comparing closely with previous types of the same manufacture. The Woods Motor Vehicle Company has added an I-beam front axle to its latest Model 1012, which is operated by a special four-pole series motor supplied from a 40-cell battery. A drum-type controller is used, combining the forward and reverse motions in one handle. The Waverly Electric Company has developed a new type of transmission and control, which is well exemplified in one of its new coupés. The motor is spring-mounted from the body of the car, and transmits its driving torque through a universal shaft to the rear axle. The new types of machines also show longer wheelbases. A roadster machine in the same booth, fitted with the type K system of control and wheel steer, is designed to make from 75 miles to 90 miles on one charge at a speed of 25 miles per hour.

Manufacturers and dealers in electrical accessories for the automobile field are represented at the 1910 show as follows:

Apple Electric Company, ignition and electric lighting system for automobile lamps; American Ever Ready Company, batteries, spark-plugs and special automobile tungsten lamps; Atwater-Kent Manufacturing Company, spark coils; Briggs & Stratton, ignition systems; Badger Brass Manufacturing Company, electric automobile headlights; Bosch Magneto Company, make-and-break and jump-spark ignition systems, magnetos; Connecticut Telephone & Electric Company, ignition systems; C. Cowles & Company, head lamps; Excelsior Supply Company, tungsten lamps and adapter spring sockets; High-Frequency Ignition Company, ignition systems; Kokomo Electric Company, ignition systems; Lovell-McConnell Manufacturing Company, Klaxon motor-driven horns; Lavalette & Company, magnetos; Motsinger Device Manufacturing Company, magnetos; National Carbon Company, dry cells; Never-Miss Spark-Plug Company, spark plugs; National Coil Company, spark coils; Pittsfield Spark Coil Company, spark coils; Point Spark-Plug Company, spark plugs; Standard Auto Supply Company, spark plugs; United States Light & Heating Company, storage batteries; Vesta Accumulator Company, storage batteries; Warner Instrument Company, speed-indicating meters; Vanguard Manufacturing Company, spark plugs; Witherbee Igniter Company, ignition systems.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Trade in general showed a tendency last week to be considerably quieter than at any time within the past few months. This was especially noticeable in retail lines, and is probably attributable to the agitation now going on for lower prices for the necessaries of life. Buyers are inclined to be conservative. and prices are unsettled. Quite a number of orders, however, were reported during the week by the jobbing houses and wholesalers, and traveling salesmen reported very satisfactory business throughout the South and Northwest. Many of these orders may be taken subject to future reductions in price. The weather has been such as to offer no interference with transportation, and to encourage the movement of farm products to market. In the manufacturing world activity continues to be as great as ever, and in spite of the unsettled condition of the securities market there seems to be no let up in the orders that continue to pour in upon the industries, especially those connected with the iron and steel trade. Although it is a trifle early, interest is already beginning to develop in the excellent prospects for coming crops. Winter wheat has been distinctly benefited by the heavy snows that have prevailed during the past six weeks throughout the far Northwest. Collections are very little better than they have been for the past two months. Failures for the week ending Feb. 3, as reported by *Bradstreet's*, were 233, against 295 for the previous week; 286 for the same week in 1909; 272 in 1908; 198 in 1907, and 204 in 1906.

THE COPPER MARKET.

Very little business was done in the copper market during the past week, and, while prices remain about stationary in this country and show trifling decline in Europe, there seems to be small buying from actual consumers. It is the general belief that the melting of copper is proceeding more actively than at any time within the past two years, but the majority of the consumers were well stocked and are willing to stay out of the market until their warehouses are further depleted. There seems to be little room for doubt that the copper producers' statement for January will be favorable so far as the statistics of the industry are concerned. The deliveries for both export and the domestic account were heavy, although they were mainly for sales made some months ago. The production is known to have been reduced, and the curtailment of mining operations is still in force. Although there has been small progress made in the direction of consolidation on the part of the miners, there seems to be a practical agreement that over-production will not again be permitted to demoralize the market in the manner that was done last summer. The European warehouses are loaded with metal, and bankers abroad have about all of the copper they care to carry. Unless there is actual buying by customers within the next two months. the conditions of the producers will be little benefited by the reduction of output. The total exports for the month, including Feb. 7, have been 10,460 tons. The figures in the table quote standard copper at the daily call Feb. 7:

	Bid.	Asked.	Settling price.
Spot	13.00	13.20	....
February	13.00	13.20	13.10
March	13.00	13.20	13.10

Market dull.

The London prices Feb. 7 were as follows:

	Noon. £ s d	Close. £ s d
Standard, copper, spot	59 10 0	59 7 6
Standard copper, futures	60 7 6	60 5 0
Market	Firm	Easy
Sales of spot		1,200 tons
Sales of futures		1,200 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50	13.10
London, spot	£62 0 0	£59 7 6
London, futures	62 18 9	60 5 0
London, best selected	65 10 0	63 5 0

Improvement in Marconi Service.—William Marconi, who arrived in New York last week, says that by May all of the improvements that the company has been adding to its trans-Atlantic stations would be completed and that the news service would be resumed. New apparatus has been installed at the Glace Bay station. He said the efficiency of the service had been greatly improved in both transmitting and receiving messages and that it would be able to maintain a daily average of 20,000 words instead of 4000 or 5000 as was formerly the case. The British Government has recently taken over some of the Marconi stations for use in connection with its telegraph and telephone service. He said that the fitting up of the vessels of the merchant marine, particularly the liners, had become almost universal and that arrangements had been made which gave the operators a ranking place among the ship's officers and provided a telegraph office on board.

Active Demand for Storage Batteries.—Within the last three months there has been an extremely active demand for storage batteries, especially for small installations. Although the new Edison battery has not been advertised as yet a great number of inquiries has been received and many orders placed. An official of the Westinghouse Storage Battery Company declares that the plant at Boonton, N. J., which was destroyed by fire Feb. 6, had up to that time been working overtime, and in some instances double time, in its effort to catch up with the large number of orders that had been booked. He said that not only was the factory as busy as it could be, but that inquiries and business in prospect made it apparent that batteries would be in demand during the entire year. The Electric Storage Battery Company also reports that its shops are fully engaged, and that orders have been booked far ahead.

Long Island Railroad.—The Long Island Railroad Company began work last week on the big central station and office building at Jamaica. This work will be pushed forward rapidly, so that it will be ready for use when the electric service is put in operation next summer. When this work is completed all of the lines east and west of Jamaica, except the North Shore Road and the Rockaway Beach division, will converge in this station. There will be a straight, low grade, high-speed four-track road between this station and the big terminal in Manhattan. The entire operation on this portion of the road will be by electricity.

Railroad Telephones a Success.—So much success has attended the use of telephones in handling trains on the Mahanoy and Hazleton division of the Lehigh Valley Railroad that the system has been extended to the main line between Easton and Penn Haven Junction, Pa. It is stated that as rapidly as it can be done the use of telephones will be extended on the Lehigh system. It has cost the road about $30,000 to equip 152 miles with this service. The officials think that one of the best features of the service is the fact that the train despatcher may talk directly with the engineer or conductor of a train, thus avoiding many mistakes.

Westinghouse Storage Battery Plant Burns.—The factory buildings of the Westinghouse Storage Battery Company at Boonton, N. J., were destroyed by fire, Feb. 6, with the exception of the power house. A high wind was blowing at the time, and the intense cold prevented the fire department from successfully checking the flames. The loss is placed at about $240,000, with $180,000 insurance. A new factory will be built at once.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at St. Louis, Mo.; Prescott, Ariz.; Calgary, Alta., Can.; Caryville, Tenn.; Waynesboro, Va.; Highbridge, Ky.; El Reno, Okla.; Salina, Utah; Winnipeg, Man., Can.; London, Ont., Can., Entait, Wash.; Green Bay, Wis., and Eau Claire, Wis.

Catalogs Wanted.—G. C. Motwane, Sukkur Sind, India, is desirous of obtaining from manufacturers of American electrical apparatus complete catalogs describing their products. He writes that the market for American goods in a country with over 300,000,000 inhabitants and of immense resources is good, provided the devices combine with excellence the element of low cost.

Heavy Business in Railway Equipment.—All of the electrical companies manufacturing street-railway motors, controls and other equipments report that they are so overcrowded with work that deliveries are likely to fall behind schedule. The street-railway companies, as a rule, bought very little until the spring of 1909. Then a few large orders were put in and the equipment makers were kept fairly busy. Beginning in September small orders from every part of the country began to pour in to the manufacturers, until at the present time they are practically swamped. A representative of the Westinghouse Electric & Manufacturing Company says that the railway-motor department of that company's plant is working night and day, is scouring the country for additional skilled labor and is practically congested with motors in process of manufacture. He also says that the company has been delayed to some extent by difficulty in securing the necessary steel castings, the steel mills being in much the same condition. Other electrical companies report the same situation with regard to railway equipment. A representative of the American Locomotive Company, which makes street-railway trucks, said that so many orders had been received within the last few months from street-railway companies that the plant was likely to be seriously behind in its deliveries. It is the general impression that the street-railway companies waited until the last moment to put in their orders, and that the long service of much of the equipment now in use is the cause of their insistence at the present time.

United Wireless Telegraph Company.—The United Wireless Telegraph Company has completed and put into service its new station at Eastport, Maine. This station has a wide range and is intended to keep the service in touch with transatlantic liners. Plans have also been made for a new station on Montauk Point, L. I., which will have a radius of something like 1000 miles. Speaking of the annoyances caused by amateur stations an official of the United Company said that it had reached the point where some legislation seemed absolutely necessary. He said that messages had recently been sent to nearby cities by amateurs on the United's New York signal letters and these had been received by operators as genuine. He said that during a recent storm one of these mischief-makers near Boston sent out a distress signal reporting that two steamers had collided off Cape Cod and were sinking. Several tugs and relief vessels were immediately rushed to the scene and many hours spent searching for the distressed ships.

Mt. Shasta (Cal.) Power Company.—John Coffee Hays, president, treasurer and consulting engineer of the Mt. Shasta Power Company, organized to promote a hydroelectric plant in California, says of the project that it is intended to construct a dam on the Pitt River in Shasta County. The company, he says, is not connected with any other, and is incorporated under the laws of California, with a capital of $1,000,000, all common. Construction work has not yet been commenced, and it is estimated that it will require four or five years to complete the plant and transmission lines. It is expected to develop about 200,000 hp. In addition to Mr. Hays the other officers of the company are W. A. Cooper, vice-president, and R. E. Johnson, secretary. The main office of the company is at Visalia, Cal.

Demand for Automobile Motors.—The demand for motors for automobiles has become so heavy that the Westinghouse Machine Company last week sent six representatives to different parts of the country looking for expert electrical workers. The company wants at least 300 of these skilled mechanics. The rush of business in this line, it is said, is totally unprecedented. The Machine company reports that 300 automobile motors were ordered within 48 hours, and that all of the work is required for rush delivery. It is stated that the leading automobile manufacturers of the country are counting on turning out an aggregate of 150,000 cars during the present year.

Nome Electric Light & Power Company.—Advices have been received from Nome, Alaska, that Scotch capitalists have purchased the Nome Electric Light & Power Company. This company was owned by the John J. Sesnon Company. The plant was taken over in November and placed under the new management, with Arthur Gibson in charge. It is understood that a new plant will be built west of the Snake River, which will be equipped with turbo-generators, and that a new transmission line will be extended to many mining camps not now reached.

Westinghouse Electric & Manufacturing Company.—The Westinghouse Electric & Manufacturing Company has recently sold to the Inland Empire Railway Company, of Spokane, Wash., the complete equipment for the second half of the power plant that the railway company has constructed at Nine Mile. This equipment includes two 3000-kw generators, two 3000-kw three-phase 6600-volt transformers, high-tension switches, switchboard, etc. Orders have also been placed with the Westinghouse company for two 1500-kw synchronous motor generator sets, four 2000-kw 60,000-volt single-phase transformers, with switches, etc., for substations.

Shawinigan Water & Power Company.—The Shawinigan Water & Power Company, of Montreal, has awarded contracts for the following equipment: To the Canadian General Electric Company, two 2220-kw, three-phase, 50,000-volt transformers to be installed at Shawinigan Falls; one 2000-kw, three-phase transformer for south cable house at Three Rivers; to Canadian Westinghouse Company one 3000-kw, three-phase transformer, for north cable house at Three Rivers; one 4000-kw, three-phase transformer for Montreal terminal substation, and one 3000-kw generator for Shawinigan power house.

American Arc Lamp Posts for Rio de Janeiro.—The J. L. Mott Iron Works, of New York, have secured a contract from F. S. Pearson for 750 iron arc lamp posts to be installed in the streets of Rio de Janeiro, Brazil. The posts will be of the "Bishop's Crook" type now used in New York City, and were selected by the engineers of Dr. Pearson's office in preference to designs submitted by European builders. Dr. Pearson is president of the Rio de Janeiro Tramway, Light & Power Company, which has the contract for the illumination of the streets of the Brazilian capital.

The Whiting Electrolytic Process.—The Whiting Company, 131 State Street, Boston, Mass., announces that it owns and controls the Whiting Electrolytic process for the production of caustic soda and bleaching liquor or powder and that it is prepared to arrange for the design, construction and operation of independent plants or plants to be operated in connection with pulp, paper or textile mills. The Whiting process is stated to be in successful operation on a large scale at the plant of the Oxford Paper Company, at Rumford Falls, Maine.

Dix River (Ky.) Hydroelectric Development.—A company is about to be organized in Kentucky for the purpose of constructing a hydroelectric plant on the Dix River, near Highbridge, Ky. The name of the company will probably be the Central Kentucky Power Company, and it is expected that the initial development will amount to 6000 hp, which can later be increased to 10,000 hp. L. B. Herington, president of the Richmond (Ky.) Electric & Power Company, is promoting the new development.

Development at Laidlaw, Ore.—H. H. Humphrey, of Kennewick, and associates have purchased the two Awbrey Falls and the B. F. Nichols Falls on the Deschutes River, close to Laidlaw, Ore. It is stated that a large water-power development will be constructed, which, it is estimated, will develop between 40,000 and 50,000 hp. The purchasers are said to have ample financial backing to carry out the project. A town site containing 1000 acres has been contracted for.

Clark Electric Meter Company of Chicago.—The Clark Electric Meter Company, 126 South Clinton Street, Chicago, was incorporated with capital stock of $2,500 on Jan. 31. The concern has been doing business for several years, however. It manufactures voltmeters and ammeters and repairs electrical instruments, and it also does meter testing. The officers are: President, Eugene J. Clark; secretary and treasurer, John L. Axen. Iven Axen is also one of the incorporators.

Arizona Power Company.—Plans have been prepared by the Arizona Power Company for the construction of a second hydroelectric plant on Fossil Creek. Work on this plant will soon be commenced. It is estimated that 3000 hp can be developed, which will increase the output of the company to 15,000 hp. The energy is being sold to the various mining camps in the neighborhood of Prescott, Ariz.

S. Morgan Smith Company.—The S. Morgan Smith Company, York, Pa., has secured the contract for furnishing to the Montreal Light, Heat & Power Company for its station at Lachine generating equipment which will increase the output of the plant by about 5000 hp.

Butte Electric & Power Company.—The Butte Electric & Power Company has just closed an important contract for the sale of power to be used for irrigation purposes. This business is in its nature supplemental to the company's regular business for supplying power and light for mines. It is expected to be operated only for the three months when the flow in Montana streams is greatest, or, in other words, when the company has a surplus product for sale. It is figured that this additional revenue will be secured at practically no additional expense. The price charged is somewhat above the average price now received for the hydroelectric power sold for other purposes.

Sevier (Utah) Light & Power Company.—A company has recently been organized in Utah, known as the Sevier Light & Power Company, which has secured control of the Salina Mill & Power Company, of Salina, Utah. Improvements will be made on the existing plant and a hydroelectric development will be constructed in Salmon Canyon, at Rattlesnake Hill. The company proposes to furnish lights for the Gunnison and Sevier valleys, to operate the present mill and to build a gypsum mill with an output of 400 tons. The capital of the new company is $100,000.

Brown Electric Company, Chelan, Wash.—Plans have been prepared for the Brown Electric Company, of Chelan, Wash., for the construction of a hydroelectric plant on the Entait River. A concrete dam 480 ft. long and 55 ft. high will be erected, and a concrete pipe, half a mile long and 10 ft. in diameter, will connect with the power house. About 5000 hp will be developed and the estimated cost of the development is $500,000. Ray & MacKean, Seattle, are the engineers who have drawn the plans.

Etowah River (Ga.) Hydroelectric Development.—The contract for the power development on the Etowah River, near Creighton, Ga., for the Blue Ridge Power Company, has been awarded to Frank B. Gilbreth, Inc., 60 Broadway, New York. This work will include the construction of a Ransom hollow dam 42 ft. high and 600 ft. long, and a reinforced-concrete power house sufficient for a 4000-hp electrical generating plant.

Riverside Light & Power Company, Virginia.—The recently incorporated Riverside Light & Power Company, of Waynesboro, Va., has purchased the entire property of the South River Electric Light & Power Company. It is proposed to enlarge and improve the property by installing a 200-hp engine, direct-connected to a 200-kw generator.

Lamp-Making Machinery Wanted.—The firm of Nicanor Garcia y Lastres, Lima, Peru, proposes to establish a factory for renewing incandescent lamps, and writes to say that it desires to receive from makers of machinery for this purpose prices on a complete equipment. It also desires prices on filaments for renewed lamps.

Financial Intelligence.

THE WEEK IN WALL STREET.

The condition of the stock market is extremely unsatisfactory. In fact, the demoralization of prices and the general weakness of the market's tone are so pronounced that they are beginning to have some effect on the condition of commercial business. During the earlier part of the past week the market was very weak and declined several points. On Feb. 4 and 5 some effort was made to brace up prices and there was a pause in the decline, but very little gain was made. On Feb. 7 such selling pressure was exerted that prices crumbled on every active issue, and there was almost, for a time, a state of panic. While it is true that the majority of the trading is conducted by speculators and by professionals, there is very little encouragement derived from this fact. In a word, the entire condition of the market is weak. During last spring and summer the bears made repeated attempts to break prices, but they were always routed. To-day the tables are exactly turned. Any selling movement develops a general decline, and all efforts at support seem to be half-hearted and inefficient. For this condition none of the outside reasons assigned is sufficient explanation. While there is considerable nervousness over the position of the administration toward corporations, this is not enough to explain the present weakness. The money market is satisfactory, and the only reasonable explanation is that investors are entirely out of the market, and that inflation had been carried too far by the bull operators. Money Feb. 7 was quoted: Call at 2¼@2⅞ per cent; 90 days, 3¾@4 per cent. The quotations in the table are those of the close Feb. 7.

NEW YORK.

	Jan. 31.	Feb. 7.	Shares sold.		Jan. 31.	Feb. 7.	Shares sold.
All.-Ch.	13½	11½	1,600	Int.-Met., pfd.	55	45½	39,300
All.-Ch., pfd.	46*	37½	2,500	Mackay Cos.	89	86¾	900
Amal. Cop.	82	72¼	220,950	Mackay C., p.	77	76⅞	500
Am. D. T.	20½*	20½*	———	Man. Elev.	136½	135	1,020
Am. Loc.	52½	47⅜	13,800	Met. St. Ry.	25*	18	200
Am. Loc., pfd.	112½*	110	300	N.Y.&N.J.Tel.	139¼*	139¼*	———
Am. Tel. & C.	76*	77	212	Steel, com.	82	75½	1,307,524
Am. T. & T.	137⅜	135¼	15,060	Steel, pfd.	123¼	118	15,532
B. R. T.	72¾	69½	22,235	W. U. T.	71½	69¼	3,864
Gen. Elec.	153½	147½	4,700	West'h., com.	72	63½	8,880
Int.-Met., com.	21½	18¼	51,550	West'h., pfd.	123*	121	20

PHILADELPHIA.

	Jan. 31.	Feb. 7.		Jan. 31.	Feb. 7.
Am. Rys.	47½	45⅞	Phila. Elec.	14⅛*	14⅛
Elec. Co. of A.	12⅛	12⅛	Phila. R. T.	27	25¾
Elec. St. B'ty.	59¾	56½	Phila. Trac.	88⅛	88½*
E. S. B'ty, pfd.	30*	30*	Union Trac.	51½	50⅜

CHICAGO.

	Jan. 31.	Feb. 7.		Jan. 31.	Feb. 7.
Chi. City Ry.	180*	180*	Chi. Tel. Co.	128	128
Chi. Rs., Ser. 1	107½*	107½*	Met. El., com.	17*	17*
Chi. Rs., Ser. 2	30	29	Met. El., pfd.	56	51
Com. Edison	116	115	Nat'l Carbon	108*	106½
Chi. Subways	3¾*	3½*	Nat'l Car., pfd.	118*	116¼

BOSTON.

	Jan. 31.	Feb. 7.		Jan. 31.	Feb. 7.
Am. T. & T.	137½	135⅜	Mex. Tel.	3¾	3½
Cum. Tel.	147	147*	Mex. Tel., pfd.	5½	6
Edison E. Ill.	244	245	N. E. Tel.	136	135½
Gen. Elec.	153*	151	W. T. & T.	15*	15*
Mass. E. Ry.	17	16	W. T. & T., pfd.	91*	91*
Mass. E. R., pfd.	81	80			

* Last price quoted.
Shares sold are for week of Jan. 31 to Feb. 5.

New York Edison Company Increases Directorate.—Stockholders of the New York Edison Company have certified to the Secretary of State that its number of directors has been increased from seven to eleven. Besides the holdings of the Consolidated Gas Company of New York, the following comprise all the stockholders of the company: Anthony N. Brady, Samuel A. Beardsley, Nicholas F. Brady, James A. Bennett, L. C. Bogert, Harrison L. Gawtry, Henry J. Hemmens, John W. Lieb, Jr.; Thomas H. Murray, Stephen S. Palmer, William Rockefeller, James Stillman, Benjamin Whitely, Lewis B. Gawtry, George F. Baker, John W. Sterling, Frederick Geller and Augustus V. Heely.

Detroit United Railway Report.—For the year 1909 the Detroit United Railway Company reports a surplus of $769,535 after all deductions have been made. This compares with $651,928 in 1908. There was expanded for additions and betterments during the year a total of $354,537, and for road and new equipment $287,299. At the annual meeting last week the question of a dividend was briefly discussed, but it was decided that no action would be taken in this respect for at least three years from the date of the last payment, which was in August, 1907. It was decided that the surplus, which now amounts to $3,244,539, should be utilized for improvements.

Hudson Companies Financing.—It was announced last week that the Hudson Companies has made arrangements through Harvey Fisk & Sons for the sale of a further issue of notes to a syndicate represented by J. P. Morgan & Company. The notes will be secured by bonds of the Hudson & Manhattan Railroad, of which $100,000,000 are authorized. These notes will bear 5 per cent interest and will run 3 years. The proceeds will be used for completing the tunnel system as originally planned and the money for the construction of the extension from Thirty-third Street to Grand Central Station will have to be provided by future financing.

Fall River Electric Light Company.—At the annual meeting of the stockholders of the Fall River (Mass.) Electric Light Company last week, the stockholders voted to increase the capital stock of the company from $600,000 to $800,000 for the purpose of constructing extensions to the underground conduit system. The Gas Commissioners of Massachusetts will be asked to permit this increase, and will fix the price at which the new stock will be issued. The balance sheet for the year shows totals assets, Dec. 31, 1909, of $1,228,469.

Northern Ohio Traction Company.—The annual report of the Northern Ohio Traction & Light Company for the year 1909 shows a gross revenue of $2,177,641, as compared with $1,890,473 in the previous year. This is an increase of 15.02 per cent.

United Railways of Baltimore.—A statement was made last week to the effect that the existing voting trust of the United Railways & Electric Company of Baltimore would be dissolved at its expiration, one year hence, and that no effort would be made to renew it. It seems to be the prevailing opinion that there is no necessity for a continuance of the voting trust inasmuch as the new financial plan of the company has been practically worked out. The voting trust was created in 1906 and ran for two years. There was much opposition to its renewal, but it was finally decided to continue it for three more years. The company is now in good shape and its earnings for 1909 were about the best it has ever experienced.

Stone & Webster's Properties Prosper.—The consolidated statement of the electric lighting, railway, gas and water-power companies under the management of Stone & Webster, of Boston, for the year 1909 shows total gross earnings of $20,241,974, operating expenses of $11,582,862 and surplus after payment of interest charges and taxes of $4,162,762. The capitalization of the 30 companies amounts to $62,997,500 in outstanding bonds and notes and $63,198,120 in preferred and common stock. The railway companies have 1005 miles of track and during the year carried 274,567,000 passengers. The total lighting connections amount to the equivalent of 1,778,000 16-cp lamps and the power to about 83,638 hp.

Lacombe Electric Company, Denver.—It is reported in Denver that a party of capitalists is negotiating to secure control of the property of the Lacombe Electric Company and to apply for a franchise to furnish light and power to the city. Although it has been generally understood that the control of this property was taken over by the Denver Gas & Electric Company in 1906, a suit has recently been brought against the latter company by some of the old bondholders and there is a dispute over the ownership. It is said that the stockholders of the Lacombe company have never agreed to the purchase price fixed by the Denver Gas & Electric Company.

Colorado Railway, Light & Power Company.—Since the Colorado Railway, Light & Power Company took over the property of the Southern Colorado Power Company it is said that it has disposed of $1,000,000 of bonds of the $5,000,000 issue in Paris and $1,000,000 to the stockholders of the latter company. The Walston H. Brown Company, of New York, will soon offer to the public $1,000,000 of these bonds at 92½ with a 50 per cent stock bonus. The new company is building additions to its plant and transmission lines, and is preparing to extend its service to coal mines and other properties in the southern part of Colorado.

Narragansett Electric Lighting Company.—At the annual meeting of the Narragansett Electric Lighting Company, of Providence, R. I., the stockholders elected four new directors, as follows: Richard A. Robertson, Walter K. Sturges, Howard L. Clark and Arthur B. Lisle, which makes the number of directors now 19. The income account for the year showed gross earnings of $1,195,369, and operating expenses of $669,123. After charging off interest, taxes and a liberal amount for depreciation there was a surplus remaining of $344,623.

United States Motor Company.—It has been announced in Hartford, Conn., that the Columbia Motor Car Company, of that city, has been absorbed by the United States Motor Company, the new $16,000,000 holding corporation which recently took over the Maxwell-Briscoe plants at Tarrytown. It is stated that the new holding company will include among its stockholders Thomas F. Ryan, the William C. Whitney estate, A. N. Brady, the Elkins estate of Philadelphia, P. A. B. Widener, of Philadelphia; Grant B. Schley, and the Electric Storage Battery Company.

Juniata Water & Water-Power Company.—The property of the Juniata Water & Water-Power Company, of Tyrone, Pa., was sold at auction under foreclosure proceedings Jan. 24. The property was purchased by J. W. Bell, of the firm of Bell & Judge, New York, for $400,000. A new company will be organized and the plant improved. The foreclosure proceedings were brought by the Trust Company of North America, New York, as trustee for $750,000 first-mortgage bonds. The company was incorporated in 1904, and supplied energy for the Juniata Valley.

Southwestern Consolidation of Utilities.—A party consisting of N. E. Henderson, Seaton Porter and Francis Blossom, of the engineering firm of Sanderson & Porter, has recently made a trip of inspection of several plants in the Southwest, under escort of C. K. Durbin, of Denver. This trip, it is said, is in connection with the probable consolidation of the public utilities in Albuquerque, Roswell and Las Vegas, N. M., and Tucson, Ariz. Mr. Durbin is interested in all of these properties. No definite plan for the combination has yet been announced.

Western Electric Company's Report.—The annual report of the Western Electric Company for its fiscal year, which ended Nov. 30, 1909, shows that the gross receipts were $45,575,000, and that the expenses were $43,206,000, leaving net earnings of $2,369,000. The surplus, after paying fixed charges, was $2,089,000, which was equal to 13.9 per cent on the capital stock of the company. An abstract of the report will be found on page 337.

Schott Engineering Company.—No statement of assets and liabilities has been given out as yet by the Central Trust Company of Illinois, which was recently appointed receiver for the Schott Engineering Company, of Chicago. Work on the company's construction contracts in various parts of the country is being carried on by the receiver. These contracts relate mostly to the installation of district-heating systems.

North American Company.—The actual net income of the North American Company for 1909 was $1,706,876. This is an increase of 18 per cent over 1908, and is equivalent to 5.73 per cent on the $29,793,300 capital stock, as compared with 4.86 per cent in 1908.

Jeanesville Iron Works Sold.—Announcement has been made that the International Steam Pump Company has purchased the Jeanesville Iron Works at Hazleton, Pa. This plant is one of the largest industries in the Hazleton section.

DIVIDENDS.

American Smelters' Securities Company, quarterly, preferred "A," 1½ per cent; preferred "B," 1¼ per cent, payable March 1.

Brooklyn Rapid Transit Company, quarterly, 1 per cent, payable April 1.

Chicago City Railway Company, quarterly, 1½ per cent, extra 4 per cent.

National Carbon Company, preferred, quarterly, 1¾ per cent, payable Feb. 15.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
Cumberland Telephone & Telegraph Company:					
Year 1909	$6,615,368	$3,879,440	$2,735,928	$579,081	$2,156,847
Year 1908	6,141,818	3,662,972	2,478,845	485,415	1,993,430
Detroit Edison Company:					
Year 1909	2,199,143	1,274,578	924,565	511,702	412,863
Year 1908	1,592,811	920,474	672,337	428,649	243,688
Detroit United Railway Company and Subsidiaries:					
Year 1909	8,047,555	5,042,724	3,004,831	2,380,129	769,535
Year 1908	7,114,760	4,559,123	2,555,637	1,968,665	651,928
Laclede Gas Light Company:					
Year 1909	4,142,350	2,240,609	1,901,741	1,004,094	897,647
Year 1908	3,716,406	1,936,747	1,779,659	1,002,238	777,421
Long Island Railroad Company:					
December, 1909	626,545	486,670	204,021	.....	.....
December, 1908	538,752	503,326	108,782	.....	.....
Milwaukee Electric Railway & Light Company:					
Year 1909	5,709,946	3,680,420	2,029,526	1,257,974	771,552
Year 1908	5,462,582	2,354,877	3,107,705	1,524,288	1,524,417
Nashville Railway & Light Company:					
Year 1909	1,724,379	1,013,882	710,497	394,352	316,145
Year 1908	1,597,029	954,296	642,733	393,099	249,634
Philadelphia Company, Pittsburgh:					
Year 1909	18,247,516	10,338,535	7,908,981	4,583,453	3,606,800
Year 1908	16,583,425	9,718,870	6,801,555	4,483,079	2,564,206

General News

Construction News.

NOME, ALASKA.—It is reported that the Nome electric light and power plant, owned by John J. Sesnon Company, of Seattle, Wash., has been purchased by Scotch capitalists, represented by Col. Stuart Weatherly and Col. Fox Ramsey, who have incorporated the Seward Peninsula Power Company. It is proposed to construct a new plant on the sand spit west of Snake River. The new plant will be equipped with turbine engines and will furnish electricity for mining purposes and for lamps for Nome and other Seward Peninsula mining camps. The transmission lines will be extended to Solomon, 40 miles distant, where much dredging is contemplated.

PRESCOTT, ARIZ.—Preparations are being made by the Arizona Power Company for the construction of a second hydroelectric power plant on Fossil Creek, work on which will begin soon. It is estimated that 3000 hp can be developed, which will increase the output of the company to 15,000 hp. The company furnishes electricity to the various mining camps in this region.

McGEHEE, ARK.—The City Council has awarded the contract for construction of electric light and water plants to Y. Q. Woodward, of Pine Bluff, Ark., at a cost of $25,000.

CHICO, CAL.—It is reported that Scott Hendricks, of Chico, Cal., is interested in a project to form a company to establish a telephone system through Plumas, Lassen and Modoc counties. It is proposed to make direct connection with the valley system at Oroville.

COMPTON, CAL.—The City Council has granted the Consolidated Utilities Company a 30-year franchise to erect and maintain transmission lines over the streets and highways of the city for the distribution of electricity for lamps, heat and motors. H. T. Dunning is city clerk.

FLORIN, CAL.—A bill of sale has been recorded whereby the American River Electric Company has purchased the electric distributing plants in Florin and Elk Grove from E. Oppenheim, which include about 25 miles of pole line.

HERMOSA BEACH, CAL.—The trustees of Hermosa Beach have closed a contract with the Edison Electric Company of Los Angeles for the installation of arc lamps on all thoroughfares where street work is in progress, which will involve an expenditure of more than $250,000.

LOMPOC, CAL.—The Town Trustees are considering the question of purchasing the plant of the Lompoc Light & Power Company to be operated by the municipality. It is proposed to call an election and submit the proposition to a vote. J. T. Worthington is manager of the Lompoc Light & Power Company.

LOS ANGELES, CAL.—The Board of Supervisors has authorized bids to be called for an air compressor with a capacity of 500 cu. ft. per minute, installing transmission line and furnishing electricity for operating same.

LOS ANGELES, CAL.—The Southern California Edison Company has applied to the Board of Supervisors for a franchise for a large number of transmission lines in Los Angeles County. The board has ordered the franchise advertised.

MONROVIA, CAL.—Henry Bolaski, is reported to be interested in a project to construct an electric railway in Monrovia.

OAKLAND, CAL.—The People's Electric Light & Power Company has voted to issue bonds to the amount of $250,000. The company is capitalized at $500,000 and proposes to establish a distributing plant near San Leandro. D. U. Toffelmeir is president, and C. L. Best, secretary of the company.

OAKLAND, CAL.—The Oakland Gas Light & Heat Company has agreed to furnish electricity for illuminating purposes to Alameda County at the rate of 3½ cents per kilowatt-hour, and 3 cents per kilowatt-hour for motors, which is the same rate that the company furnishes the service to the City of Oakland.

POMONA, CAL.—It is reported that the Edison Electric Company, of Los Angeles, is contemplating improvements to its local system which will involve an expenditure of about $100,000.

POMONA, CAL.—Plans have been prepared for extensive improvements to the street lighting system by a committee composed of business men of the city. It is proposed to use curb lamp posts.

PORTERSVILLE, CAL.—R. D. Laidlaw, of Los Angeles, Cal., and associates are reported to be interested in a project to build an electric railway from Portersville to Tulare, Poplar, Woodville, Springville and Globe, 87 miles long. It is said that sufficient power will be available from the water rights now controlled by parties promoting the railway.

RIVERSIDE, CAL.—Extensive improvements are contemplated by the Pacific Telephone & Telegraph Company to its plant in this city which include the installation of 7000 ft. of underground conduit, three miles of underground cables, 20 miles of 22-gage and 19 miles of 19-gage aerial cable. A new exchange building is being erected on Orange Street.

SACRAMENTO, CAL.—The Sheldon Townsite and Realty Company has been incorporated in Sacramento, Cal., for the purpose of building a town at Sheldon, on the line of the Central California Traction Company, which proposes to operate an electric railway between Sacramento and Stockton. The company proposes to install its own electric light plant and water works system. G. W. Peltier, P. W. Kissel, of Sacramento, and J. C. Coffing, of Florin, Cal., are incorporators.

SAN RAFAEL, CAL.—The Chamber of Commerce, it is reported, is considering plans for the construction of an electric railway to extend from Ross Valley through San Rafael to McNear's Point. E. B. McNear and D. W. Martens are interested in the project.

VISALIA, CAL.—We are informed that the Mt. Shasta Power Company, recently incorporated, proposes to construct a large water power development, transmission system, the plant to be located on Pitt River, in Shasta County. As yet the heavy construction work has not been started and when commenced will take four or five years to complete. The proposed plant will have an output of about 200,000 hp. The main office for the present will be located in Visalia. John Coffee Hays is president.

DENVER, COL.—The Denver Gas & Electric Company has announced a reduction in the price of electricity for lamps from nine to eight cents per kw-hour, to take effect from Jan. 1, 1910. Beginning with July 1, 1910, the price of gas will be reduced from $1 to 90 cents per 1000 cu. ft.

WARD, COL.—It is reported that the Audabon Power Company, which proposes to construct a power plant at Ward, Col., has placed its bonds and will commence work on the construction of its plant as soon as the weather will permit. It is estimated that the plant will develop about 600 hp and will supply electricity for mines and mills in this district. J. E. Haggard is interested in the project.

BRIDGEPORT, CONN.—Plans are being considered by the Bridgeport Malleable Iron Company for the installation of a new power plant to replace the plant now in use.

BRISTOL, CONN.—Announcement has been made by the Bristol & Plainville Tramway Company of a reduction in the price of electricity to consumers on its meter service from 17½ cents to 15 cents per kw-hour, the new schedule to take effect from Feb. 1.

DANBURY, CONN.—The Danbury & Bethel Electric Light Company has increased its capital stock from $200,000 to $300,000.

WASHINGTON, D. C.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Feb. 24 for furnishing lamp standards and brackets that may be required for various buildings under control of the Treasury Department. Plans and specifications can be secured at the office of the supervising architect. James Knox Taylor is supervising architect.

WASHINGTON, D. C.—Bids will be received until Feb. 15 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., for furnishing at the Navy Yard, Brooklyn, N. Y., the following supplies: Schedule 2205—20 globes and 1100 interior fittings, an electric motor, switchboard, 1200 ft. No. 0 weatherproof wire, 200 lb. double cotton-covered and 50 lb. double silk-covered magnet wire. Applications for proposals should designate the schedule desired by number.

PENSACOLA, FLA.—The Lakeview Street Car Company has applied to the City Council for a franchise to construct and operate an electric railway on several streets in Pensacola. The company will soon apply for a charter with a capital stock of $20,000. J. E. Baars, Jr., Theodore Baars and John W. Bullock, Jr., all of Pensacola, Fla., are interested in the project.

ST. PETERSBURG, FLA.—Application has been made to the City Council by R. E. Ludwig and associates, of Sarasota, Fla., for a franchise to construct and operate an electric light and power plant in St. Petersburg.

ATLANTA, GA.—Preparations are being made by the Atlanta Steel Company for the installation of two steam turbines in its plant at Brookwood, which are to be operated by the exhaust steam of two large engines already installed. The turbines will replace ten smaller engines, aggregating about 1200 hp. The cost of the machines is estimated at about $75,000. T. K. Glenn is president of the company.

CREIGHTON, GA.—The contract for the construction of the hydroelectric power plant on the Etowah River, near Creighton, Ga., for the Blue Ridge Power Company has been awarded to Frank B. Gilbreth, Inc., 60 Broadway, New York, N. Y. The work will include the construction of a Ransome hollow dam, 42 ft. high and 600 ft. long, and a reinforced-concrete power house with sufficient space for 4000-hp installation.

IDAHO FALLS, IDAHO.—Preparations are being made by the Idaho Falls Electric Railway Company to commence work about April 1 on its proposed electric railway to connect Idaho Falls, Lincoln, Ammon, Iona and Heise. The company is capitalized at $1,000,000. J. L. Milner is president and A. V. Scott is treasurer, both of Idaho Falls, Idaho.

SHOSHONE, IDAHO.—The Shoshone Light & Water Company is reported to have decided to install an auxiliary steam power plant. F. W. Gooding is president.

CHICAGO, ILL.—The Garden City Plate Manufacturing Company, it is reported, is contemplating the purchase of a 100-hp automatic engine and electric generator during this month.

CHICAGO, ILL.—Contracts have been awarded by the Board of Trustees of Sanitary District of Chicago, Chicago, Ill., to the Westinghouse Electric & Manufacturing Company for motor-generating set for operation of eight-track bridge and Western Avenue bridge over the main drainage channel for $3,280, and for induction motor for pumping station at Thirty-ninth Street and Lake Michigan in Chicago for $6,170. The contract for gearing, bearings and shafting was awarded to the Charles F. Elmes Engineering Works, of Chicago, Ill., for $2,770. Bids for testing transformers were rejected. I. J. Bryan is clerk board of trustees.

HAWTHORNE, ILL.—The Western Electric Company is reported to be preparing plans for an addition to its power plant.

MURPHYSBORO, ILL.—The Murphysboro & Southern Illinois Railway Company is planning to place contracts in the near future for the construction of its proposed electric railway to connect Carbondale, Herrin, Duquoin, Carterville and Shawneetown, 70 miles in length. Contracts have already been placed by the company for bridge and trestle work and for building a new car house. C. H. Clay is general manager.

NORTH CHICAGO, ILL.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until March 1 to furnish at the naval training station, North Chicago, Ill., two freight elevators and hand lift. Application for proposals should refer to schedule 2202. Blank proposals will be furnished upon application to the navy pay office or to the above bureau. E. B. Rogers is paymaster general, U. S. N.

BLUFFTON, IND.—The Marion, Bluffton & Eastern Traction and the Bluffton, Geneva & Celina Traction Companies, having been refused the privilege of taking over the municipal electric-light plant and furnishing the city with electricity for lamps, have taken steps to bring suit to enjoin the City Council from making any further expenditure for improvements or repairs to the plant.

BUTLERVILLE, IND.—The Butlerville, Hyde & San Jacinto Telephone Company, recently incorporated, it is said, proposes to purchase material and equipment for the installation of a telephone system in Butlerville, Dupont and Hyde. B. Haugh, G. M. Silver and Henry Reid are directors.

ELWOOD, IND.—The City Council is considering the question of a new contract for street lighting; the present 10-year contract expires this month. The Council has authorized the light committee to advertise for bids for furnishing electricity for not less than 100 lamps of 2000 cp for a term of 10 years.

EVANSVILLE, IND.—The Burns Construction Company, of Chicago, Ill., has secured the contract for the construction of the proposed electric railway of the Evansville, Mt. Carmel & Olney Electric Railway Company from Evansville, Ind., to Olney, Ill., 62 miles in length.

FORT WAYNE, IND.—The Board of Public Works has instructed the city clerk to purchase Nos. O, 6 and 10 weather-proof copper wire (a duplicate of the order placed a few weeks ago) for use in extending the transmission lines of the municipal electric-light plant.

INDIANAPOLIS, IND.—Plans are being prepared by the Central Union Telephone Company for the construction of a new exchange in Woodruff Place. An addition to the large switchboard in the main exchange is being installed.

INDIANAPOLIS, IND.—Rubush & Hunter, architects, are reported to have been instructed to prepare new plans and specifications on which bids will be asked for lighting fixtures for the new city hall. All previous bids have been rejected. The cost of the work is estimated at $25,000.

JEFFERSONVILLE, IND.—Announcement has been made by the new owners of the Jeffersonville Water & Light plant that bids willl be asked for extensive improvements to the plant, including new equipment. James P. Goodrich is president of the company.

MISHAWAKA, IND.—Plans are being made to install underground trunk telephone lines between Mishawaka and South Bend this spring. When this work is completed the automatic telephone system now being installed in South Bend by the Home Telephone Company will be extended to Mishawaka.

MONTICELLO, IND.—The Tippecanoe Electric & Power Company is reported to be contemplating doubling the output of its auxiliary steam plant by the installation of an additional generator.

NORTH MANCHESTER, IND.—The Browne Mills Electric Company is contemplating the installation of new high-pressure boilers as soon as either the day or night load increases 40 to 50 hp. Will probably use Heine or Babcock & Wilcox boilers. J. A. Browne is president and manager.

SULLIVAN, IND.—Local merchants have organized a telephone company under the name of the Mutual Telephone Company and have secured a franchise to erect a telephone system in this city.

AKRON, IA.—An election will soon be held to submit the proposition to issue $10,000 in bonds for a municipal electric light plant. Investigations are now being made in reference to establishing a plant.

BOONE, IA.—The Boone Electric Company is reported to be preparing plans for rebuilding its plant.

CHARLES CITY, IA.—C. W. Hart, of Charles City, is reported to have offered to subscribe $100,000 toward the construction of a street railway in Charles City, providing an additional $100,000 is subscribed by the residents of this city. It is proposed to construct an interurban railway covering a radius of about 40 miles in the surrounding country.

WEBSTER CITY, IA.—Plans are being considered for improvements to the municipal electric-light plant which include the installation of an alternating-current lighting system and with direct-current power service, or an entire new plant. R. J. Mullins is manager.

HIGHBRIDGE, KY.—It is reported that Sanderson & Porter, 52 William Street, New York, N. Y., consulting engineers, have been engaged to take charge of the construction of the proposed hydroelectric plant on the Dix River, near Highbridge, Ky. It is understood that 6000 hp will be developed at first, which will be increased to 10,000 hp. It is said that a company will be organized under the name of the Central Kentucky Power Company, or the Commonwealth Hydro-Electric Company of Kentucky to operate the plant. L. B. Herington, president of the Madison Electric Power Company; J. H. Dean, W. S. Moberly and T. L. Fitch, all of Richmond, Ky., are interested in the project.

LOUISVILLE, KY.—The stockholders of the Louisville Lighting Company have approved of the proposed issue of capital stock to the amount of $1,150,000 and of $1,000,000 in 6 per cent bonds. As yet nothing definite has been done in regard to the proposed improvements to the plant. S. M. Sackett is president of the company.

MIDDLESBORO, KY.—The Hignite Coal Mining Company is contemplating the installation of an electric light plant in connection with its coal mine, at a cost of $14,000.

CLINTON, LA.—The Town Council has passed an ordinance levying a special tax of four mills for a period of 15 years to put into effect the bond issue recently voted by the taxpayers for purchasing and operating an electric light plant.

BOOTHBAY HARBOR, MAINE.—Amos F. Gerald, of Fairfield, Maine, and Luther Maddocks, of Boothbay Harbor, are reported to be interested in a project to construct an electric railway to connect Boothbay Harbor and South Newcastle, a distance of 10 miles.

CANTON, MAINE.—The Canton Board of Trade has appointed a committee to look into the question of establishing an electric lighting system in the town. Nathan Reynolds, G. L. Wadling and Dr. F. W. Morse are members of the committee.

LUBEC, MAINE.—The plant of the Lubec Electric Company, which has been idle for three years, will be sold for taxes. The plant was established in 1901. It is understood that the plant has never been a paying proposition.

LAUREL, MD.—It is reported that bids will be received in April by the Sussex Light & Power Company for a 450-hp, tandem compound, condenser engine and a 300-kw generator.

SMITHVILLE (P. O. FEDERALDSBURG), MD.—The Smithville Electric Light Company is considering the question of rebuilding its plant, including the installation of a crude-oil engine and 60-cycle generator; also the erection of a transmission line to Edgerton, Md.

DANVERS, MASS.—The Electric Light Commission has announced a reduction in the price of electricity for lamps from 11 to 10 cents per kw-hour, the new schedule to go into effect March 1.

FALL RIVER, MASS.—The stockholders of the Fall River Electric Light Company have voted to increase the capital stock of the company from $600,000 to $800,000, the proceeds to be used for reducing the floating indebtedness and for the construction of underground conduits and extension of the distributing system. Jerome C. Borden is president.

FALMOUTH, MASS.—Plans have been prepared by the Buzzards Bay Electric Lighting Company for lighting all the villages in the Town of Falmouth. The company is awaiting the action of the town meeting to be held Feb. 15 in regard to the acceptance of the plans for power house and pole locations, etc. It is proposed to erect a power plant in Falmouth to furnish electricity for street and commercial lighting.

NEW BEDFORD, MASS.—The E. E. Taylor Company has awarded the contract for the construction of a four-story addition to its plant, the construction of a fireproof boiler room and power house and the installation of an entirely new power plant to the Z. B. Davis Corporation.

SOUTHBRIDGE, MASS.—Preparations are being made by the Hamilton Woolen Company for new 100-kw electric power plant, work on which will begin as soon as possible.

SPRINGFIELD, MASS.—The contract for the electrical work for the auditorium and municipal office building to be erected on Court Square, in Springfield, has been awarded to the M. B. Foster Company, of Boston, Mass., for $21,325.

WORCESTER, MASS.—The Worcester Consolidated Street Railway Company has decided to make improvements to its system, which will involve an evpenditure of about $302,500. The work will include laying of considerable track, 30 miles of trolley wire and overhead work, 12 new overhead switches and the purchase of 15 new bench open cars. L. S. Storrs is vice-president of the company.

OTSEGO, MICH.—W. A. Foote, of Jackson, Mich., is reported to have purchased the real estate and the water power of the Otsego Light & Power Company. The Hoag flouring mill and machinery are still held by the company.

EAST GRAND FORKS, MINN.—The Grand Forks Railway Company has applied to the City Council for a franchise to construct and operate an electric railway through the principal streets of the city. The proposed railway will extend from Grand Forks to Oslo. C. H. Anderson, of East Grand Forks, is interested in the project.

MARSHALL, MINN.—The Northwestern Telephone Exchange Company, it is said, contemplates rebuilding its exchange and making other improvements to its system, which will involve an expenditure of about $25,000.

PINE RIVER, MINN.—Arrangements are being made by the Pine River Rural Telephone Company to construct a telephone line to the Popular-Hazel Dell country, 30 miles in length; also a line from Emily to Little Pine, a distance of about 20 miles, and possibly a third line to connect Swanburg with Longville.

VIRGINIA, MINN.—Application has been made to the City Council by W. M. Prindle, of Duluth, Minn., for a franchise to construct an electric railway in Virginia. The proposed railway is to be extended to Eveleth and Gilbert.

ST. LOUIS, MO.—Sealed proposals will be received at the office of the Board of Public Improvements, Room 300, City Hall, St. Louis, Mo., until Feb. 15, as follows: No. 9755—For furnishing and erecting four water tube boilers in the new power house at the City Insane Asylum. No. 9756—For furnishing and installing two automatic engines in the new power house at the City Insane Asylum. No. 9757—For furnishing and installing two three-wire, direct-current generators and switchboards in the new power house at the City Insane Asylum. 9758—For furnishing and installing one refrigerating and ice making plant in the new power house and new kitchen building on the grounds of the City Insane Asylum. Specifications may be seen and blank proposal forms may be secured at the office of the president of Board of Public Improvements. Maxime Reber is president.

MILES CITY, MONT.—E. L. Benson, representing Eastern capitalists, is contemplating the purchase of the local electric light plant and the installation of water power.

CRAB ORCHARD, NEB.—It is reported that a new company has been formed to take over the plant and holdings of the Crab Orchard Electric Company. The new company, it is understood, proposes to make improvements to the plant, including the installation of new equipment.

OMAHA, NEB.—A contract has been entered into between the Omaha Electric Light & Power Company and the Cudahy Packing Company, whereby the former is to furnish electricity to the Cudahy company, beginning Feb. 1. The company announced some time ago that it would construct a new power house, but has decided not to build for the present. The Cudahy company uses about 1000 hp, of which the electric company will furnish 600 hp.

CANAAN CENTER, N. H.—Application has been made to the Selectmen for permission to erect transmission lines in Canaan Center for a proposed electric lighting system.

KEENE, N. H.—The Keene Gas & Electric Company, which is extending its transmission lines from the present terminus at West Swanzey to Winchester and Ashuelot, has decided to extend the lines to Marlboro, Troy and Fitzwilliam. The Winchester line will ultimately extend to a point near Hinsdale, where connection will be made with the high-tension lines of the Connecticut River Power Company. The directors of the Keene Gas & Electric Company are negotiating with the Connecticut River Power Company for connection with the power company's lines for the purchase of power in large quantities.

CAMDEN, N. J.—The Armstrong Cork Company, of Camden, N. J., has placed an order with the Allis-Chalmers Company, Milwaukee, Wis., for a gas-engine generator unit, consisting of an 18 x 24 tandem horizontal double acting, and will operate on producer gas, direct connected to a 200-kw, 250-volt, 200-r.p.m., direct-current generator.

GARWOOD, N. J.—Arrangements are being made to enlarge the power plant of the Æolian Company at Garwood, N. J. The company, it is said, will be in the market for boilers, condensers, engine-driven generators, pumps, etc., together with machinery for its new shops.

KEYPORT, N. J.—Plans are being considered by the Whitall Tatum Company for the construction of a factory in Keyport, with power plant. An engine, dynamo and other equipment will be required.

MILLVILLE, N. J.—George Wood, president of the Millville Traction Company, is reported to have submitted a proposition offering to construct a railway to Port Norris, providing the residents along the route will subscribe to $75,000 in capital stock at 5 per cent interest. The stock of the Millville Traction Company is to be merged with the new line.

NEWARK, N. J.—It is reported that the Oscar Barnett Foundry Company, of Newark, N. J., will soon purchase equipment for a 300-hp power plant to be installed in its new shops, which will include boilers, heater, pumps, Corliss engine and generators, together with cranes, motors and operating equipment.

ALBUQUERQUE, N. M.—The Santa Fe Railroad Company is reported to be contemplating the construction of a new power plant in Albuquerque to supply power to operate its local shops. The cost of the plant is estimated at $13,000.

ALBUQUERQUE, N. M.—It is reported that plans are under way for the consolidation of the electric public utilities in the cities of Las Vegas, Albuquerque and Roswell, N. M., and Tucson, Ariz., and other southwestern towns. C. K. Durbin, of Denver, Col., is interested in light and power plants in the above-named cities.

BUFFALO, N. Y.—Bids will be received at the office of the Department of Public Works, City and County Hall, Buffalo, N. Y., until Feb. 18 for eight 750-hp water tube boilers for the pumping station, Bureau of Water, foot of Porter Avenue, Buffalo, N. Y. For coal and ash handling machinery for new pumping station, Bureau of Water, Buffalo, N. Y. For one 30-ton electric traveling crane for new pumping station at the foot of Porter Avenue, Buffalo, N. Y. For feed pumps, feed water heater and purifying system for pumping station at foot of Porter Avenue, Bureau of Water, Buffalo, N. Y. For five 30,000,000-gal. vertical, triple expansion engines for Buffalo water works. A separate proposal must be made for each part of the work and supplies included. Plans and specifications may be seen and printed forms can be secured on application to the Bureau of Water. Francis G. Ward is commissioner of Public Works.

ELMIRA, N. Y.—The Public Service Commission, Second District, has authorized the Elmira Water, Light & Railroad Company to acquire all the capital stock of the Montour Falls Electric Light Company and to issue a $20,000 mortgage for the purpose of acquiring this stock. The company is also authorized to exercise franchises in the towns of Horseheads, Veteran and Montour for the purpose of distributing electricity in the above-named towns and extending its transmission lines through these towns to Montour Falls. Permission was also given the company to extend its transmission lines in the towns of Southport and Elmira, where franchises have been granted.

JOHNSBURG, N. Y.—The North Creek Electric Company, of North Creek, N. Y., has been granted permission by the Public Service Commission, Second District, to exercise the franchise granted by the Town of Johnsburg to construct and operate an electric system in this town, and to issue $20,000 in bonds, the proceeds to be used for the construction of the plant. The company proposes to construct a hydro-electric power plant and to secure water from Long and Clear ponds.

OSWEGO, N. Y.—The Last-Long Underwear Company is contemplating the installation of electric motor driven machinery in its new plant.

ROCHESTER, N. Y.—The Allis-Chalmers Company, of Milwaukee, Wis., is installing a 900-hp and 2100-hp hydraulic turbines for the Rochester Railway & Light Company.

EDENTOWN, N. C.—Plans are being considered for the installation of a 75-kw, alternating-current, direct-connected unit in the municipal electric-light plant and establishing a day service. J. C. Martin is superintendent.

GREENSBORO, N. C.—At an election to be held March 29 the proposition to issue $125,000 in bonds for the construction of an electric light plant will be submitted to a vote.

DICKINSON, N. D.—Arrangements are being made by Hughes & Deiters, owners of the local electric light plant, for extensions and improvements to the plant, which will involve an expenditure of about $15,000. An order has been placed for a 327-hp, cross compound Buckeye engine, which will drive a 200-kw generator.

CINCINNATI, OHIO.—Sealed proposals will be received at the office of the clerk of the Board of Education, City Hall, Cincinnati, Ohio, until Feb. 28 for furnishing and installing, complete, electric fixtures and lamps in the new Hughes High School building, corner of Clinton Avenue and McMillan Street. Plans and specifications can be seen at the office of C. W. Handman, business manager, 511 West Court Street, Cincinnati.

ALTUS, OKLA.—At an election held Feb. 1 the proposition to issue $200,000 in bonds, the proceeds to be used for improvements to the municipal electric-light plant, water works and sewerage systems, was carried.

EL RENO, OKLA.—Preparations are being made by the Canadian Mill & Elevator Company for the installation of a complete power plant. The equipment will consist of a 200-kw generator, to be driven by a 250-hp engine; 350-hp Corliss engine, two 175-hp boilers, surface condenser, cooling tower, etc.

BANDON, ORE.—The Bandon Light & Power Company is reported to be preparing plans to double the output of its plant. About two miles of transmission lines will be erected and many new street lamps installed.

BUXTON, ORE.—It is proposed that Hans Peterson, of Forest Grove, Ore., has decided to install an electric light plant and water works system in Buxton.

DRAIN, ORE.—The City Council has passed an ordinance to light the city with electricity and to enter into a contract with the Drain Electric Light & Power Company for a term of 20 years. Under the terms of the franchise the company is to begin work on construction of its plant within 30 days and to have it completed within eight months.

EUGENE, ORE.—Plans are being made to install an independent electric light and power plant in the new Osburn Hotel, to be installed in the basement of the building, to furnish electricity for lamps and elevator. John Hunzicker is architect.

FLORENCE, ORE.—Application has been made to the City Council by T. J. Monroe, of Coos Bay, for a franchise to construct and operate an electric light plant in Florence.

FOREST GROVE, ORE.—The City Council has authorized the Mayor to proceed with the purchase of machinery for a municipal electric-light plant for Forest Grove.

MARSHFIELD, ORE—.The Union Traction & Terminal Company has commenced work on the construction of its electric railway between Marshfield and North Bend. The power plant and repair shops will be located in Marshfield. J. M. Blake, of Marshfield, Ore., is president.

PORTLAND, ORE.—The Alder Street Improvement Association has decided to place cluster lamps on the curb the entire length of the street. A committee has been appointed to investigate the cost and secure designs for same.

PORTLAND, ORE.—The Portland, Eugene & Eastern Railway Company has agreed to build several extensions to its city street railway system, including a loop five miles in length out South Willamette Street past College Hill and then again into the city by the way of Oregon Avenue and at the intersection of Eleventh and Willamette Streets, for a bonus of $35,000. A. Welch is purchasing agent.

CLAIRTON, PA.—The County Commissioners have granted the Peters Creek Street Railway Company a perpetual franchise to construct and operate a street railway over the county road between Wilson and Clairton boroughs. W. G. Wilson, of Dravosburg, Pa., is president of the company.

DUMORE, PA.—The Scranton & Lake Shore Railway Company has been granted a franchise by the City Council to operate an electric railway over Dunker Street. The company is planning to construct a railway from Dumore to Lake Ariel. William F. McGee, Walter Haslan, of Scranton, Pa.; J. J. Reagan, of Dunmore, and Richard Foote, of Archbold, Pa., are interested in the project.

HAZLETON, PA.—Plans are being prepared by the Wilmot Engineering Company of Hazleton, Pa., for a gas-producer power plant with an output of 300 hp. The equipment, it is said, will probably include two electric units of 100 kw each, air compressor, hoist, etc., for coal operations in the Blue Ridge Mountains.

HUNTINGDON, PA.—The plant and holdings of the Juniata Water & Water Power Company, located near Huntingdon, was sold at auction Jan. 24 by Barnes & Lofland under foreclosure proceedings, subject to the decree of the court, to J. W. Bell, of the firm of Bell & Judge, of New York, N. Y., for $400,000. The proceedings for the sale were instituted by the Trust Company of North America, which acted as trustee in the bond issue of $750,000, interest on which was defaulted. The company was incorporated in 1904 to supply electricity for lamps and motors throughout the Juniata Valley. The officers of the company are: H. L. Greylin, president; W. I. Forbes, vice-president and treasurer, and S. S. Garwood, secretary, all of Philadelphia, Pa.

PITTSBURGH, PA.—Orders have been placed by the Jones & Laughlin Steel Company, of Pittsburgh, Pa., with the Allis-Chalmers Company, of Milwaukee, Wis., for an 18 x 24 single tandem horizontal double acting engine having cylinders 48 x 84 x 60-in. stroke.

PITTSBURGH, PA.—The Edward E. Rieck Company, of Pittsburgh, Pa., has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a horizontal, cross-compound condensing-type gas engine which will operate on natural gas. The engine will be direct connected to a direct-current, 120-volt, 200-r.p.m. generator.

POTTSTOWN, PA.—Preparations are being made by the Light Manufacturing Foundry Company, of Pottstown, Pa., for the installation of a 200-kw power plant in the spring, for which boilers, engine, dynamo and other equipment will be required.

POTTSTOWN, PA.—The Chadwick Engineering Works, of Pottstown, Pa., it is said, is contemplating the installation of a new power plant within six or eight months, the equipment of which will consist of a 150-hp Corliss type engine, direct connected to a 220-volt, direct-current generator and boilers of from 200 to 250 hp. The company is not prepared to take up the matter of purchasing the machinery at the present time.

DILLON, S. C.—It is reported that the city is offering a 20-year franchise for an electric light plant and water-works system. The city has a population of about 3500. A committee, consisting of W. L. Betha, E. R. Hamer and C. L. Wheeler, has been appointed to take charge of the matter.

ORANGEBURG, S. C.—It is reported that plans are being prepared for the construction of an electric railway to connect Orangeburg and Branchville and intervening towns. A plant located on the Edisto River will furnish electricity to operate the system. William C. Wolfe and others are interested in the project.

SIOUX FALLS, S. D.—The Dakota Portland Cement Company is reported to have decided to erect a large power plant on the Missouri River, near Chamberlain, S. D. It is said the plant will be driven by steam turbines. Alternating current motors will be used to operate the machinery.

CARYVILLE, TENN.—Preparations are being made by the Red Ash Coal Company for the installation of an alternating-current electric power plant, to cost about $18,000. Contracts for electric equipment have been placed with the General Electric Company, of Schenectady, N. Y. C. M. Moore is president.

BRYAN, TEX.—Plans are being prepared by J. D. Shaw, of Shaw & Fountain, of Houston, Tex., for the proposed electric light and water plant in Bryan, for which a franchise was recently granted by the City Council.

DALLAS, TEX.—Preparations are being made by the Dallas Traction Company to begin work on construction of its proposed railway, which will connect the Mount Auburn addition with the consolidated lines in Dallas, in about 60 days. Electricity for operating the system will be furnished by the Dallas Electric Light & Power Company. E. L. Lancaster, of Dallas, Tex., is general manager.

ELGIN, TEX.—Thomas L. Deisch, of Helena, Ark., who recently secured a 25-year franchise to construct an electric light plant, is planning to organize a company under the name of the Elgin Light & Power Company to construct and operate the plant, to cost approximately $14,000.

QUANAH, TEX.—Wiley W. Lowry, of Poteau, Okla.; Elmer S. and Fox Woods, of Fort Smith, Ark., are reported interested in a project to construct an electric interurban electric railway from Altus to Quanah, Tex., a distance of 35 miles.

SAN MARCOS, TEX.—It is reported that the San Marcos Utilities Company is contemplating the installation of a waterwheel in its plant to utilize the water power of San Marcos River.

PROVO, UTAH.—Jesse Knight has applied to the City Council for a franchise to construct an electric railway in Provo. The proposed railway, it is said, will extend from Payson through Provo to Murray.

SALINA, UTAH.—Negotiations have been closed whereby the control of the Salina Mill & Power Company has been taken over by a new company known as the Sevier Light, Power & Milling Company. Improvements will be made to the plant, which will involve an expenditure of about $50,000 and include the construction of a power plant on what is known as Rattlesnake Hill, in Salmon Canyon. The company proposes to furnish electricity for lamps in the Gunnison and Sevier valleys and also to operate the present roller mill and a gypsum mill with an output of 400 tons, which the company proposes to erect. The capital stock is placed at $100,000.

RUTLAND, VT.—The Rutland Railway, Light & Power Company is reported to be considering the question of installing a 1500-hp generator in the Carvers Falls plant, recently purchased by the company.

WAYNESBORO, VA.—The Riverside Light & Power Company, recently incorporated, has purchased the plant and holdings of the South River Electric Light & Power Company, which it proposes to enlarge. It is proposed to install a 200-hp Corliss or turbine engine direct connected to a 200-kw generator. William A. Pratt is president and manager of the company.

WILLIAMSBURG, VA.—The question of improving the present lighting system is under consideration. E. W. Warburton is Mayor.

BELLINGHAM, WASH.—Arrangements are being made by the Whatcom County Railway & Light Company for the construction of an electric interurban railway to extend from Bellingham south to Skagit County, 33 miles in length. L. H. Bean is local manager.

ELLENSBURG, WASH.—Plans are being considered for improving the municipal electric light plant located on the Kakima River, two miles west of the city. It is proposed to install an auxiliary steam power plant and enlarge the canal.

ENTAIT, WASH.—Plans have been prepared by Ray & MacKean, 320 Pacific Block, Seattle, Wash., for the Brown Electric Company, of Chelan, Wash., for the construction of a hydroelectric power plant on the Entait River to cost about $500,000. The work will include the erection of a dam 480 ft. long and 55 ft. high, a concrete pipe one-half mile long and 10 ft. in diameter and concrete power house. About 5000 hp will be developed. It is said that bids for construction of the plant will be awarded in April.

EVERETT, WASH.—It is reported that the Sultan Railway & Power Company, which proposes to construct a large power plant at the Sultan Canyon, will construct an electric railway from the Great Northern power plant site, a distance of about 16 miles, this season, to transport the machinery for its proposed plant at the head of Sultan Canyon. The Sultan Company is under contract with the Government to commence work on its railway before July 1, 1910. It is estimated that 45,000 hp can be developed.

SPOKANE, WASH.—The Board of Public Works has awarded the contract for three transformers with protection devices for the pumping plant to the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for $7,175.

SPOKANE, WASH.—The Inland Empire Railway Company, of Spokane, Wash., has recently placed a contract with the Westinghouse Electric & Manufacturing Company for complete equipment for the second half of its power plant at Nine Mile, which includes two 3000-kw generators, two 3000-kw three-phase, 6600-volt transformers, high-tension switches, etc. An order has also been placed with the same company for two 1500-kw synchronous motor generator sets, four 2000-kw, 66,000-volt, single-phase transformers, switchboard, etc., for substation.

VANCOUVER, WASH.—Mayor Higgins in his message to the City Council recommends the installation of a municipal water plant, placing of all electric, telephone and telegraph wires underground and additional street lamps for the newly annexed territory.

CHARLESTOWN, W. VA.—The contract for street lighting has been awarded by the City Council to the Charlestown Light & Power Company

for a term of three years. Under the terms of the contract the company is to furnish 62 incandescent lamps and 37 arc lamps at $2,520 per year.

WHEELING, W. VA.—Bids will be received until March 9 at the United States Engineer's Office, Wheeling, W. Va., for construction of fireproof power house, installing 100-hp gas engines, air compressors, receivers, piping, etc., for drilling a well at each of the dams, Nos. 8 and 11, Ohio River. Bids will be considered on the entire plant for each dam, or for houses, machinery, etc., separate. For further information address Captain F. W. Altstaetter.

GREEN BAY, WIS.—The Northern Paper Mills, of Green Bay, Wis., it is reported, will require two new machines for an addition to its plant, together with auxiliary equipment. Machinery for power plant will also be installed, including boilers, engines, electric generators, motors, etc. For further information address O'Keefe & Orbison, engineers, Appleton, Wis.

GREEN BAY, WIS.—Bids will be received by the special building committee of the Board of Supervisors of Brown County until March 15 for furnishing and placing in position all of the wood and metal furniture, electric fixtures and furnishing material and decorating the new court house building now being erected at Green Bay, Wis., in accordance with plans and specifications prepared by C. E. Bell, architect. Plans and specifications can be seen at the office of Elmer S. Hall, county clerk, Green Bay, and at the office of C. E. Bell, architect, 901 Northwestern Building, Minneapolis, Minn.

MANITOWOC, WIS.—The Stephenson Mills at Cato Falls, Wis., have been purchased by Chicago capitalists, headed by Charles Stewart. It is said that the water power will be developed for commercial purposes. Surveys will soon be made, and it is expected that the plant will be erected this summer.

CHEYENNE, WYO.—Bids will be received by Captain V. K. Hart, acting quartermaster, at the office of the constructing quartermaster, Cheyenne, Wyo., until March 2, for construction, etc., of the following public buildings at Fort Russell, Wyo.: (1) For construction, plumbing, heating, electric wiring and electric fixtures, for two administration buildings, plans No. 122-F; one guard house, plans No. 206; one set of quarters for four officers, plans No. 237-B. (2) For construction, plumbing, electric wiring and electric fixtures for one stable, quartermaster's department, plans No. 139-L. (3) For construction and plumbing for one vehicle shed, plans No. 209. (4) For construction only of one storehouse for powder house, plans No. 263; one storehouse for ammunition, plans No. 262, and one icehouse, plans No. 196-A. Plans and specifications are on file in the above office; also at the offices of the chief quartermasters, Department of the Lakes, Chicago, Ill.; Department of Missouri, Omaha, Neb.; Department of Colorado, Denver, Col.; office of the depot quartermaster, St. Louis, Mo., and at the office of the secretary of the Builders' Exchange, St. Paul, Minn. Copies of plans and specifications may be secured from the office of the constructing quartermaster, Cheyenne, Wyo., upon deposit of $5, which will be refunded upon return of the same.

CALGARY, ALTA., CAN.—The Calgary Power & Transmission Company has awarded the contract for the construction of its plant to the Walter Tyshe Company, of Montreal, Que., Can.

CALGARY, ALTA., CAN.—We are informed that improvements contemplated by the Calgary Water Power Company to its plant during 1910, include the installation of an 800-hp Babcock & Wilcox boiler, one 750-hp, Robb-Armstrong engine and a 500-kw, alternating current, three-phase, 60-cycle, 2000-volt, Westinghouse generator. P. A. Prince is vice-president and manager.

CLAYBURN, B. C., CAN.—Plans are being made by the Clayburn Brick Company to operate its machinery by electricity. Orders have been placed with the Allis-Chalmers-Bullock Company for one 200-hp motor, four 40-hp, one 20-hp and two 10-hp motors.

CRANBROOK, B. C., CAN.—The Cranbrook Power & Light Company has made application to the Legislature for permission to develop the water power of St. Mary's River in East Kootnay.

PRINCE RUPERT, B. C., CAN.—It is reported that the Provincial Legislature has loaned the Town of Prince Rupert $50,000, to be used for the acquirement of the pole line of the Prince Rupert Power & Light Company and for the construction and installation of an electric light plant. The loan is to be repaid as soon as Prince Rupert shall become an incorporated city, with usual tax-levying and collecting powers.

VICTORIA, B. C., CAN.—Application has been filed by M. King for 100,000 cu. in. of water to be taken from the Campbell River at the falls just below Campbell Lake for power development purposes.

VICTORIA, B. C., CAN.—M. Hutchinson, superintendent of the municipal electric light plant, writes that 50 magnetite arc lamps are now being installed. He also states that a considerable number of tungsten lamps in clusters will be erected in the business section of the city for street lighting purposes.

WINNIPEG, MAN., CAN.—The T. Eaton Company is reported to be making preparations for the installation of large power plant on the site recently acquired on the west side of Hargrave Street. Connection will be established by a tunnel beneath the street. The new plant will have an output of 1000 hp. The machinery of the present plant will be moved to the new station.

BRANTFORD, ONT., CAN.—The Grand Valley Railway Company expects to award contracts for the construction of an interurban railway, 116 miles in length, and 12 miles of track in the city, within the next three months; also for the construction of a new power house at Brantford, the equipment of which will consist of three 500-kw motor generator sets. William P. Kellett is general manager and chief engineer.

COBALT, ONT, CAN.—The Cobalt Light, Power & Water Company is reported to have been granted permission to issue bonds to the amount of $75,000.

KENORA, ONT., CAN.—The arbitration board which was appointed to determine the values of certain lands expropriated by the Town of Kenora, owned by the Hudson Bay Company and Keewatin Company, has been decided in favor of the companies. The board valued the property of the Hudson Bay Company at $45,000 and the Keewatin Power Company at $35,000. The decision not only gives the town the lands involved, but the absolute title to the water power. Under the original clauses the town would have secured the land, but would have had to pay a yearly rental for the water privilege. The Hudson Bay Company placed a valuation on its property of $1,600,000 and the Keewatin Company $400,000. The question has been pending since 1906.

LONDON, ONT., CAN.—Bids will be received by the City of London, until Feb. 26, for electrical apparatus, including transformers, motor-generator set, voltage regulators, switchboards, lightning protectors, instruments, arc and incandescent street lighting system. For further information address E. I. Sifton, city electrical engineer.

OTTAWA, ONT., CAN.—Notice has been given by the Ottawa & Montreal Transmission Company, Ltd., that it will apply to Parliament for extensive powers in connection with its proposed hydroelectric plants and other power projects. Christie, Greene & Hill, of Ottawa, Ont., Can., are solicitors for the company.

PRESTON, ONT., CAN.—At an election held recently the citizens voted in favor of the by-laws to appropriate $18,000 for the installation of a hydroelectric distribution plant.

TORONTO, ONT., CAN.—Bids will be received by the City of Toronto until March 8 for a supply of underground cable. Specifications may be seen and proposal forms secured at the Electrical Department, City Hall, Toronto. G. R. Geary, Mayor, is chairman of Board of Control.

MONTREAL, QUE., CAN.—The Morgan Smith Company, of York, Pa., has secured the contract for additional equipment for the generating plant of the Montreal Light, Heat & Power Company at Lachine. The improvements will cost about $175,000 and increase the output of the plant by 5000 hp.

MONTREAL, QUE., CAN.—Orders have been recently placed by the Shawinigan Water & Power Company, through Julian C. Smith, chief electrical engineer, for new equipment as follows: To the Canadian General Electric Company, for two 2220-kw, three-phase, 50,000-volt transformers to be installed in its transformer station at Shawinigan Falls; one 200-kw, three-phase transformer for the south cable house at Three Rivers, Que. To the Canadian Westinghouse Company for one 3000-kw, three-phase transformer for the north cable house at Three Rivers, Que.; one 4000-kw, three-phase transformer for the Montreal terminal substation, and one 3000-kw generator to be installed at the Shawinigan power station. The new substation of the company, located at Black Lake, is nearing completion. The company is erecting a new transmission line from Three Rivers to Nicolet, Que., a distance of about 25 miles.

SASKATOON, SASK., CAN.—Sealed proposals will be received by J. H. Trusdale, city clerk, until Feb. 14 for the following copper and electrical supplies, f.o.b. Saskatoon: Four tons 00 W.P. copper wire, four tons No. 2 W.P. copper wire, four tons No. 4 W.P. copper wire, two tons No. 10 W.P. copper wire, 2000 1½-in. top pins, 3000 D. G. D. P. insulators, 2000 side brackets, 500 service insulators, 200 5-amp. meters, 100 10-in. amp. meters, four 30-kw transformers, two 1-kw transformers, 50 lb. tape, 500 ft. loom, ¾-in.; 200 lb. solder, 10 lb. solder paste, 200 strain insulators, 400 fuses, assorted; 500 ⅝ in x 16 in. for double arming, with both ends threaded and double nuts, and 3000 ⅝ in. washers. William Hopkins is mayor.

New Industrial Companies.

THE ELECTRIC SUPPLY & EQUIPMENT COMPANY, of San Francisco, Cal., has filed articles of incorporation with a capital stock of $50,000 by J. W. Thresbie, F. P. Bull and M. North.

THE HERRICK ENGINE COMPANY has filed articles of incorporation with the Secretary of State with a capital stock of $3,000,000. The incorporators are: W. N. Akers, W. J. Maloney and E. E. Davis, of Wilmington, Del.

THE HYDRO POWER COMPANY, of Portland, Maine, has been incorporated with a capital stock of $3,000,000 to deal in engines, pumps, etc. F. W. Hayden, of Randolph, Mass., is president and treasurer.

THE KENDRICK RAILWAY SWITCH COMPANY, of Schenectady, N. Y., has been incorporated by A. Levi, J. E. Inglis and B. Terk, of Schenectady, N. Y. The company is capitalized at $50,000 and proposes to manufacture and deal in railway appliances of all kinds, railway switches, electrical and mechanical devices for switches.

MASSACHUSETTS ROLLER BEARING COMPANY, of Augusta, Maine, has been incorporated with a capital stock of $2,500,000 to manufacture and deal in bearings for use on electric and other railroads. F. J. Post, of Brookline, Mass., is president and treasurer.

THE MICHIGAN MAGNETO COMPANY, of Indianapolis, Ind., has been organized with a capital stock of $15,000 for the purpose of manufacturing magnetos, ignition devices, stationary and marine engines. The directors are: Albert G. and Henry Cox and Blanche Walton Cox.

THE SURRELL DOUBLE DRAFT BOILER COMPANY, of Portland, Maine, has been incorporated with a capital stock of $1,000,000 to manufacture all kinds of machinery. C. E. Eaton is president, and T. L. Croteau, treasurer, both of Portland, Maine.

THE H. G. WHITE COMPANY, of Somerville, Mass., has been chartered with a capital stock of $30,000 for the purpose of doing an electrical contracting business. C. W. Dunton, of Somerville, Mass., is president and treasurer.

New Incorporations.

LOS ANGELES, CAL.—Articles of incorporation have been filed for the Pacific Light & Power Company with a capital stock of $40,000,000 by W. G. Kerchoff, K. Cohn, Charles Forman, A. N. Kemp, H. E. and Howard E. Huntington and George S. Patten. The company is a merger of the Pacific Light & Power Company with subsidiary companies.

RED BLUFF, CAL.—Articles of incorporation have been filed for the Sierra Irrigation Company by H. C. Swain, O. C. Combs, Alva Dennis, W. L. Bransford and J. J. Wells, all of Red Bluff, Cal. The company is capitalized at $3,000,000 and proposes to supply water for irrigation purposes and to generate and sell both electricity and gas. The incorporators are: H. C. Swain, O. C. Combs, Alva Dennis, W. L. Bransford and J. J. Wells, all of Red Bluff. This corporation is a reorganization of the Valley Irrigation Company, recently incorporated. The main office of the company will be located in San Francisco; the operating offices will be in Red Bluff, Cal.

SACRAMENTO, CAL.—The East Sacramento Water Company has been incorporated with a capital stock of $250,000 by H. J. Goethe, G. P. Beere, H. A. McClelland, T. T. Goethe, Thomas Oates, Peter Zing and Albert Elkus. The company proposes to supply water, gas and electricity in East Sacramento and other sections. It is said that the company will start in Elmhurst.

HARTLEY, IA.—The Sauer's Telephone Company has been incorporated with a capital stock of $10,000 by F. P. Watters, Wesley Watters and Louis Specht.

LODGE POLE, NEB.—The Lodge Pole Telephone Company has been chartered with a capital stock of $10,000 by Fred Lehmkuhl, A. B. Kersinger and F. G. La Selle.

ANTWERP, N. Y.—The Antwerp Light & Power Company has been incorporated with a capital stock of $45,000 by J. A. Baumert, H. M. Baumert and P. Campbell, of Antwerp, N. Y. The company proposes to furnish electricity for lamps, heat and motors.

WENAS, WASH.—The Wenas Electric Power Company has filed articles of incorporation with a capital stock of $15,000 for the purpose of constructing a transmission line into Wenas to supply electricity for pumping water for irrigation from the artesian wells of the valley. The trustees are: F. V. Sanders, L. J. Anderson, P. C. Weinman, M. B. Miles and E. G. Townsan.

Personal.

MR. WILLIAM FORTUNE, of Indianapolis, has been elected president of the New Long Distance Telephone Company, James S. Brailey, Jr., of Toledo, having resigned.

MR. J. S. NORRIS, who has been associated with the Montreal Light, Heat & Power Company for the past 13 years, has been appointed general manager of the company.

MR. J. D. SHATTUCK has been appointed manager of the Philadelphia Suburban Gas & Electric Company, a subsidiary property of the American Gas Company, of Philadelphia.

MR. EDWARD P. BURCH began a course of 12 lectures on "Electric Traction for Railway Trains" on Feb. 1 before the senior students in electrical engineering at the University of Minnesota.

MR. JOEL ROBERTS, manager and superintendent of the York (Neb.) Electric & Gas Company, has resigned his position, and Mr. Charles Pfepper has been chosen to succeed him.

MR. WILLIAM MARCONI is on a visit to this country for the purpose of superintending the completion of a wireless station at Cape Breton to replace the one destroyed by fire last year.

PROF. HENRY P. TALBOT, of the Massachusetts Institute of Technology, will deliver a lecture on Feb. 23 before the Society of Arts of that institution on "The Chemistry of Modern Illuminants."

MR. J. W. THOMPSON, formerly assistant engineer of the Mexican General Electric Company, has become chief operating engineer of the Guanajuato Power & Electric Company, Guanajuato, Mexico.

MR. THOMAS A. EDISON has started his winter vacation on his plantation at Fort Myers, Fla. It is stated that during his idle moments he will seek recreation in applying his storage battery to electric pleasure launches.

MR. GEORGE PARSONS, assistant to the manager of works of the Westinghouse Lamp Company at Bloomfield, N. J., is severing his connection with the company. Mr. Parsons' plans for the future have not as yet been announced.

MR. REMIGIO JIMENEZ, for the past eight and a half years engineer of the Havana Gas & Electric Company, has resigned that position to take up work as a consulting electrical engineer, with offices at 133 Montserrate Street, Havana, Cuba.

MR. F. D. NIMS has been appointed electrical engineer for the Western Canada Power Company at Vancouver, B. C. Mr. Nims was chief operating engineer of the Mexican Light & Power Company, Mexico, before accepting his present position.

MR. C. A. WHIPPLE has become assistant electrical engineer of the British Columbia Railway Company at Vancouver, B. C. Mr. Whipple was formerly located at Bremerton, Wash., where he was engaged in electrical development work for the U. S. Navy.

PROF. HERSCHEL C. PARKER, of the Department of Physics, Columbia University, New York, and one of the inventors of the helion incandescent lamp, will leave the university next June after 20 years of service, to devote himself entirely to research work.

MR. R. M. WILSON has been promoted to the position of chief engineer of the Montreal Light, Heat & Power Company from that of general superintendent for the company. Mr. Wilson, who has been connected with the company since its formation, will have charge of all of the steam, hydraulic and electrical installations of the company.

MR. ALBERT SPIES has resigned as editor of the *Electrical Record* to become the managing director of *Foundry News*, a new illustrated monthly publication devoted to the foundry arts, with offices in the Hudson Terminal, 50 Church Street, New York. *Foundry News* will make its first appearance in April.

MR. H. H. MACRAE, formerly general manager of the Electrical Development Company which controls the Toronto & Michigan Power Company, has been appointed general manager of the Toronto Electric Light Company, to succeed Mr. J. J. Wright, who has become second vice-president of the company. Mr. W. A. Martin has been appointed assistant general manager.

PROF. ARTHUR N. TALBOT, University of Illinois, was a recent recipient of one of the Chanute medals. This medal was awarded to Prof. Talbot by the Western Society of Engineers as the author of the best paper presented to the society on a civil-engineering subject last year. The paper was entitled "Tests of Cast-Iron and Reinforced-Concrete Culvert Pipe" and described an elaborate research which has been in progress for a number of years at the University of Urbana.

MR. PAUL F. MOTTELAY, translator of Gilbert's *De Magnete* and one of the collaborators on the A. I. E. E. *Catalogue of the Wheeler Gift*, is the subject of an appreciate notice in a British society journal. Mr. Mottelay is also an authority on bridge whist, and the notice states that his work on this subject, which is an accepted authority in this country and Great Britain, is soon to appear in a French translation, with the addition of much matter prepared by Mr. Mottelay to cover differences in French rules and codes.

MR. J. B. McCLARY has resigned as general manager of the Sheffield Company (railway, lighting and power and water works), of Sheffield, Florence and Tuscumbia, Ala., and is succeeded by Mr. W. R. Hall, formerly manager of the North Alabama Traction Company, of New Decatur, Ala. At the annual meeting of the stockholders of the Sheffield Company, held at their general office, 68 Broad Street, New York, resolutions were adopted commending Mr. McClary for his good work at Sheffield and expressing regret that their pleasant relations had been severed. Mr. McClary filled the position of manager for five years, beginning in December, 1904. Prior to his Sheffield engagement he was for 10 years general manager of the parent companies of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., and for two years after its consolidation with the gas and electric-lighting company was manager of the railway department under Ford, Bacon & Davis. He was vice-president of the American Street Railway Association in 1901 and 1902. Mr. McClary leaves Sheffield to enter the selling field, with offices in Birmingham, Ala.

Obituary.

MR. CHARLES M. HOBBS, one of the organizers of the Nevada-California Power Company, which supplies electrical energy to the larger portion of the State of Nevada, died at Dansville, N. Y., on Jan. 27, to which place he had gone to seek relief from uremic poisoning. Mr. Hobbs was manager of the company at the time of his death and resided in Denver, Col. He was 55 years old, and from 1873, when he came to Colorado, until his demise, was actively associated with leading interests of that State.

MR. JOHN C. REILLY, former vice-president of the New York & New Jersey Telephone Company, died on Feb. 5 at his residence in Brooklyn from pneumonia. Mr. Reilly was connected with the telephone company for 32 years, and up to a year ago was manager of the field in Brooklyn and Long Island. When the telephone interests were merged in New York a year ago he lost his title, but was retained by the company in the Manhattan offices as an associate of Vice-President U. N. Bethell. Mr. Reilly was 54 years old at the time of his death and is survived by a widow, two sons and two daughters.

Trade Publications.

VACUUM TUBE LAMPS, giving light which equals daylight in color value, are described in leaflet No. 23 of the Moore Electric Company, 169 Malvern Street, Newark, N. J.

TELEPHONES of the inter-communicating, automatic-key type for residences, offices, factories, banks, hospitals and public buildings are discussed fully in a booklet of the Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.

ARC LAMPS.—The Western Electric Company has issued a folder booklet dealing with arc lamps with carbon and with impregnated electrodes. The various styles are illustrated and briefly described. One of the unique illustrations shows a combination arc and incandescent lamp picture.

CARBON BRUSHES.—The American Carbon & Battery Company, Signal Hill, East St. Louis, Ill., has issued complete price-lists of its carbon brushes for direct-current motors and generators, street railway motors and fan motors. Complete information is given concerning the sizes of the brushes to be used for various purposes.

HAWTHORN INDUCTION MOTOR.—The Western Electric Company has just issued bulletin No. 5230, which describes in detail its Hawthorn type "SL" induction motor. The bulletin is well illustrated and includes a description of all the essential parts of the motor. The information it contains will be of interest not only to those who purchase induction motors but also to those who are using them.

METER-TESTING RHEOSTATS.—The Ward Leonard Electric Company, Bronxville, N. Y., has just issued a new circular covering its meter-testing rheostats. Portable meter-testing rheostats for direct and alternating-current service are shown and also portable double-voltage types for use on both 120 and 240 volts as well as heavy duty station-service testing rheostats. A fixed resistance of a portable type for use with variable resistance portable types is also shown.

DIRECT-CURRENT GENERATORS designed to be directly driven by reciprocating steam engines are described in detail in Bulletin No. 110 of the Sprague Electric Company, 527 West Thirty-fourth Street, New York. The machines discussed include motor-service and lighting generators; among the latter special mention is made of the three-wire machine, which differs from the standard generator merely in being provided with two collector rings connected to the armature winding.

PUMPS.—The Deming Pump Company, Salem, Ohio, has issued a useful diary for 1910. It is of pocket size, with leather cover, and bears the title "Every Day's Doings" as well as the catch phrase, "When Water Flows Up Hill." Aside from the diary there are many pages of maps and useful statistical matter. The 10 pages devoted to descriptions and illustrations of pumps for all purposes are very interesting and contain information about this kind of machinery which adds greatly to the value of the publication.

HIGH TENSION SWITCHES.—The Delta-Star Electric Company, Chicago, Ill., is distributing pages 1 and 2 of a new loose-leaf price list. This publication is unique in that, in addition to the description and list price of high-tension switches, it also contains a great deal of technical information explaining the well-known delta and star transformer and generator connections. Formulas are also given for calculating the current in three-phase systems and complete tables showing the current values at different kilowatt capacities.

ICE MACHINES.—An artistic bulletin issued by the Carbondale Machine Company, Carbondale, Pa., gives a well-prepared discussion of the manufacture of ice by means of the exhaust steam from power plants. The advantages to be derived by central stations from the manufacture of ice are presented in a convincing manner. A separate publication of the same company shows a large number of photographic reproductions of prominent buildings in which its exhaust steam, ice-making and refrigerating machines are employed.

REFRIGERATING MACHINERY.—The Vilter Machinery Company, Milwaukee, Wis., has issued a fully illustrated 62-page catalog devoted to refrigerating and ice-making machines, which are described in detail. These machines are well adapted for driving by means of electric motors and are well arranged for use in connection with central-station service or central-station power plants. The company has issued a 64-page booklet giving a partial list of the users of its ice-making and refrigerating machines. The plants are used in 49 States and Territories in the United States and in 11 additional countries.

MOTORS AND DYNAMOS.—Roth Brothers & Company, of Chicago, have issued bulletin No. 193, in which are described the type "T" machines which have been manufactured by the company now for a number of years. The line embraces four sizes of frames for machines rated from 4 hp to 30 hp. All parts of the apparatus are interchangeable, and no details of construction are embodied which are of an experimental nature. The type "T" machines have the bearing brackets cast integral with the frames, and the bearing yokes are bored out at the same time as the pole faces, thus insuring alignment of the parts.

ELEVATOR CONTROLLERS.—In a 128-page booklet just issued by the Cutler-Hammer Manufacturing Company, of Milwaukee, the subject of the control of electrically operated elevators is very fully covered. This company has been engaged in the manufacture of electric controlling devices for many years, and its booklet on elevator controllers is more than a mere catalog, being in fact a concise treatise on the subject. The first section contains illustrated descriptions of full magnet and semi-magnet direct-current controllers for high-speed, moderate-speed and slow-speed passenger and freight elevators, together with descriptions of side-walk lift controllers, reversible and non-reversible controllers for belt-driven freight elevators, and mechanically operated controllers for use where current conditions are extremely variable. Illustrations and descriptions are also given of such necessary elevator accessories as brake magnets, car switches, limit switches, etc. The second section of the booklet is devoted to similar controllers for use on alternating-current circuits, and the concluding pages contain tables of useful information, including suggestions regarding the proper type of motor to use in each case.

ENGINEERING DATA FOR LINE FOREMEN.—For their superintendents and foremen engaged in construction work in the field, H. M. Byllesby & Co., of Chicago, have prepared an interesting and practical pocketbook giving data on various classes of electrical line construction work. The first section, which has been issued, relates to overhead construction and specifications for materials for medium and low-tension distribution. This will be followed by two other sections, to be bound in the same cover, relating to long-distance transmission and to underground distribution. One purpose of the book is to standardize construction in the different undertakings in various parts of the country in which the company is engaged. The existing section treats of such subjects as poles, cross-arms, brackets, pins, the setting of poles, sag in wires, standard systems of guying, arrangement of circuits, etc. The book is illustrated by diagrams and includes a number of tables. The loose-leaf plan of binding is used, and the cover is of flexible leather and of a size suitable for a man's hip pocket. The book was compiled by Mr. Harold Almert, manager of the department of examinations and reports of H. M. Byllesby & Co.

BUSINESS NOTES.

THE UNIVERSAL ELECTRIC WELDING COMPANY announces the removal of its offices and demonstrating shop to the sixth floor of the Blanchard Building, 227 Borden Avenue, Long Island City, N. Y.

UNITED STATES ELECTRIC MANUFACTURING COMPANY.—Carl E. Johnson has succeeded W. W. Piddington as general manager of the United States Electrical Manufacturing Company, Los Angeles, Cal.

THE UNION ELECTRIC COMPANY, Pittsburgh, Pa., whose retail store at 414 Wood Street, was destroyed by fire on the morning of December 31, will open another store about Feb. 15 at 418 Wood Street with a complete and up-to-date stock.

THE BELDEN MFG. CO., Chicago, has moved into its new factory at 2300 Western Avenue, South. The factory contains 17,500 sq. ft. of floor space in each story and gives the firm 50 per cent more floor space and manufacturing facilities superior in every way to those of the past.

WESTERN ELECTRIC INTER-PHONES.—The Western Electric Company has adopted a new trade name for those types of telephones which have heretofore been known as "Intercommunicating" or "Private Line Telephones." These are henceforth to be known as "Western Electric Inter-phones," and the word "Inter-phone" is to be used to the exclusion of the old designations.

THE H. W. JOHNS-MANVILLE COMPANY, manufacturer of electric lamps and fuses, among other products, has leased the building at 27-29 Michigan Avenue in Chicago and will concentrate at that point the supply business at 171-173 Randolph Street and also the warehouse now on Erie Street. The building has been leased for a term of 10 years and is near South Water Street.

THE TOLEDO ELECTRIC WELDER COMPANY has moved its offices from Toledo to Cincinnati and is now located in its new factory building at Knowlton & Langland Streets, Northside, Cincinnati. The factory is fully equipped with the best and most modern tools necessary for the building of its line of welding machines, and the entire plant is motor-driven. A 75-kw single-phase, alternating-current generator supplies the power for testing the welding machines up to their full rated capacity. The shops are lighted by a motor-driven, direct-current generator, and mercury-vapor lights are largely in evidence throughout the shop. Mr. Neil Macneale, the president of the company, states that owing to the number of orders received during the month of January it will be necessary to put on a night force at once to take care of them and make the deliveries promised.

THE SOUTHERN ELECTRIC COMPANY, of Baltimore, Md., has leased for five years a large five-story building on the southwest corner of Light and German Streets which will be used as an addition to the structure now occupied by the company and will be known as the Electrical Building. Improvements calling for an expenditure of about $10,000 have been begun. The interior will be altered and fireproof doors constructed on the first, second and third floors connecting the two buildings. The first floor of the new building will be used as a retail store and for display purposes. The basement and second floor will be used as a warehouse. The General Electric Company, which now has its offices in the Continental Trust Building, will occupy the entire fourth and fifth floors of the new building. The Southern Electric Company acts as a Baltimore representative of the General Electric Company.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 1, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

947,781. APPARATUS FOR ALTERNATING THE POLARITY OF CURRENT IN ELECTRIC CIRCUITS; G. Babcock, Rochester, N. Y. App. filed June 14, 1909. For supplying direct currents to telephone exchanges during the talking and for metering which operate during the use of the subscriber's line by reversal of polarity. Two generators in series, but of opposite polarity, means for alternately exciting the fields and means for absorbing the varying current of each polarity during the operation of one or the other of the generators.

947,791. PROCESS OF RECOVERING NICKEL AND COPPER FROM ORES AND MATTES; A. Chalas, Philadelphia, Pa. App. filed May 25, 1909. Treating nickel copper ores by smelting the ore and producing nickel copper anodes, dissolving them electrolytically and precipitating the dissolved copper by circulating the solution in contact with a nickeliferous reagent.

947,821. CONTACT DEVICE FOR ELECTRICALLY WOUND MECHANISMS; B. F. Kessler, Mount Carmel, Pa. App. filed Feb. 9, 1909. For clocks, the contact member consisting of a tubular glass receptacle containing platinum electrodes and mercury within the receptacle.

947,849. ELECTRIC FURNACE; J. H. Reid, Newark, N. J. App. filed May 8, 1909. For regulating the electrodes and retaining the ore in contact therewith and separating the lighter from the heavier portions by means of a quenching tank below the electrode on the surface of which a current is created which carries off the lighter constituents and an inclined perforated shaker plate below the surface receives the material dropping on the same.

947,860. OIL SWITCH; H. L. Smith, Schenectady, N. Y. App. filed May 24, 1906. Oil switch with an automatic switch device controlled by a time limit relay, having a base and operating lever with a locking toggle and a latch for preventing collapse of the toggle when the switch is closed.

947,866. LOCK; J. W. H. Taylor, Pomona, Cal. App. filed April 19, 1909. To be operated electrically without keys or knobs by a push button and circuit. Details.

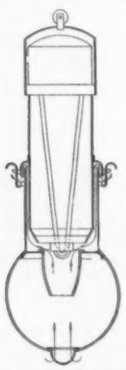
947,878. FUSELESS ROSETTE; H. C. Wirt, Schenectady, N. Y. App. filed Jan. 15, 1902. For connecting a branch electric circuit with the supply means, consisting of a single piece of porcelain or the like having a straight aperture to receive the knot in the cord and a central aperture connected therewith to receive the branch wires.

947,881. SNAP SWITCH; H. P. Ball, New York, N. Y. App. filed Dec. 4, 1905. The base carries a rigid guide frame on which the movable member travels toward and from the base, the member carrying insulated clips for securing enclosed fuses and the guide frame a latch which locks the movable member in either position, together with a spring tensioning device and trip so as to cause the movement of the member by the recoil of the springs.

947,885. INSULATOR; W. S. Cone, Visalia, Cal. App. filed April 29, 1907. For high tension conductors in which a divided cable is provided with clamps and a bar of rigid insulating material having rounding ends is loosely held in the clamps.

947,956. METERING PANEL BOARD; J. J. Agutter, Seattle, Wash. App. filed May 24, 1909. A switchboard with a base and two series of spaced and crossed conductors with contacts sliding on one series, other contacts carried thereby which may be secured to the other series of conductors.

947,957. PROCESS OF RECOVERING FINE GOLD; J. H. Alling, San Francisco, Cal. App. filed May 4, 1908. Mixes the gold



947,979—Electric Arc Lamp.

948,068—Wireless Telegraphy.

bearing material in a solution of a mercury salt and causes the mixture to flow between the upper and lower electrodes collecting the resulting amalgam at the bottom of the stream of the mixture.

947,958. APPARATUS FOR RECOVERING FINE GOLD; J. H. Alling, San Francisco, Cal. App. filed May 4, 1908. The anode is coated with mercury and the cathode consists of a pocket containing mercury, and the material is mixed with a solvent and passed between an anode and cathode, the whole apparatus being a sluice box with pockets in the bottom and anode plates with their lower edges extending toward the pockets.

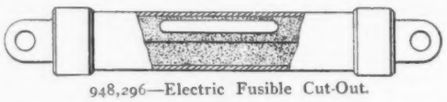
947,979. ELECTRIC-ARC LAMP; T. J. Rensing, Leipsig, Germany. App. filed Aug. 14, 1908. For preventing the deposit on the globe of a lamp by providing an outer globe with a passage for air from the outside and an inner globe open at the top and bottom so arranged that the outer globe is closed except for the air inlet and the opening formed by the inner globe prevents vapors from entering the outer globe and prevents the cooling of the inner globe.

947,981. ELECTRICAL TIME LIMIT SWITCH; P. K. Stern, New York, N. Y. App. filed March 18, 1902. Two electro-magnetic coils with a free core for one coil, a support therefor and a score for the other coil with a time limit device and operatively connected to said support so as to change the relative position of the first core and its coil on overload.

947,983. PURIFYING TANTALUM; E. Weintraub, Schenectady, N. Y. App. filed Oct. 3, 1906. Passes current through potassium tantalum fluorid.

947,987. ATTACHING PLUG; J. C. Dallam, Schenectady, N. Y. App. filed Aug. 19, 1905. Collector for electric circuits with a removable attaching plug having a pair of enclosed fuses which serve as contacts.

947,993. PROJECTOR LAMP; J. W. Kellogg, Schenectady, N. Y. App. filed July 24, 1908. Electrodes have a feed screw for each



948,296—Electric Fusible Cut-Out.

electrode which are geared together to keep the arc at the focus and are revolved by a pawl and ratchet actuated by a shunt magnet.

948,010. ELECTRIC COUPLER-ACTION FOR ORGANS; J. O. Funkhouser, Hagerstown, Md. App. filed Feb. 6, 1908. A plurality of wind chests with a pipe connecting magnet in each chest, a switch magnet for each pipe magnet, a plurality of keys in circuits, one for each switch magnet, thus permitting electric control of the organ.

948,041. COMBINED ELECTRIC CONNECTING PLUG, SOCKET AND SWITCH; W. W. Buckton, Westminster, London, England. App. filed April 24, 1909. A quick-break switch for a plug socket, the socket having a revoluble portion normally held open by a spring with means for preventing the holding of the spring as by a loosely fitting ring.

948,055. ALARM SYSTEM; O. B. Kaiser, Madisonville, Ohio. App. filed June 20, 1908. For fire protection such as a sprinkler system in which the signal circuits are set in operation upon abnormal condition of a controller and the circuit controllers are automatically operated step by step for throwing the signal transmitter into and out of circuit with the alarm circuit for transmitting the signal.

948,056. ELECTROPLATING APPARATUS; W. R. King, Newark, N. J. App. filed Sept. 30, 1909. For agitating the articles to be plated so as to permit increased density of current flow, the articles being agitated by a wave-like motion accompanied by jarring to free them from the gases.

948,068. WIRELESS TELEGRAPHY; R. A. Fessenden, Washington, D. C. App. filed July 27, 1903. Tuning antennae by altering the capacity by varying the electrostatic inductive relation between them.

948,086. DIRECTED WIRELESS TELEGRAPHY; E. Bellini and A. Tosi, Paris, France. App. filed March 2, 1909. Combines with the dirigible system a uniformly radiating system, the aerial part of which is substantially co-incident with the symmetrical axis of the aerial of the dirigible system.

948,095. ELECTRIC LIGHT FIXTURES; W. A. Hutton, Scranton, Pa. App. filed July 8, 1908. For electric light chandeliers so that they may be detachably secured in place by means of a bracket having inward shoulders to which the stem of the chandelier is secured by means of a threaded nut.

948,109. ELECTRIC LIGHT PULL INSULATOR; T. M. Harrigan, Woodstock, Vt. App. filed March 8, 1909. Has a knob on its free end and an outer knob of insulating material held on the chain by the knob so as to avoid shocks.

948,111. BATTERY BOX; R. W. Magna, Holyoke, Mass. App. filed Oct. 1, 1908. For replacing old batteries in the box by means of a resilient contact therein engaging one of the binding posts of the battery, a bracket within the box and a flexible connection attached to the bracket and carrying a contact for the other binding post.

948,154. ELECTRIC LOCOMOTIVE; W. E. Woodard, Schenectady, N. Y. App. filed Aug. 26, 1909. A separate frame carries the assembled parts of the auxiliary electric apparatus and is connected detachably to the main frame.

948,156. SYSTEM FOR THE TRANSMISSION OF ELECTRO-MAGNETIC WAVES WITH SOUND REGULATING FREQUENCIES; W. H. Bathrick, Somerville, Mass. App. filed April 3, 1908. For transmitting sound controlled radiant energy by means of a pair of secondaries, a pair of primaries, a primary generator of high frequency currents, secondaries connected with the conductors of electrical oscillations. Waves of sound actuate a diaphragm which vary the current strength of the primaries.

948,275. ELECTRORHEOSTAT REGULATOR; H. Gernsback, New York, N. Y. App. filed Sept. 1, 1908. The base of the rheostat contains an annular groove open at the top to receive the spiral resistance coil and the contact arm carries a ball touching the coil.

948,293. BALL CLUTCH FOR ARC LAMPS; J. T. Beechlyn, Lynn, Mass. App. filed July 17, 1908. An annular clutch slides on the chimney and carries a plurality of loose balls forced into gripping relation with the chimney when the ring is lifted by the lamp magnet.

948,296. ELECTRIC FUSIBLE CUT-OUT; E. Schattner, Ealing, England. App. filed June 11, 1907. The fuse contains a cooling liquid or gas such as tartaric acid which combines with soda so that when the fuse is broken the cooling fluid is liberated.